

МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
НАЦІОНАЛЬНИЙ УНІВЕРСИТЕТ ХАРЧОВИХ ТЕХНОЛОГІЙ

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АНГЛІЙСЬКА МОВА

Всі цитати, цифровий
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Посібник містить автентичні та адаптовані тексти за фахом, лексичні, граматичні та комунікативні вправи для навчання студентів перекладу оригінальних текстів та спілкування англійською мовою у сфері науки і техніки. Граматичний матеріал поданий в моделях і таблицях. Посібник складається з 16 уроків, граматичних таблиць та списку літератури.

Посібник рекомендовано для студентів — бакалаврів, магістрів, аспірантів вищих навчальних закладів та технікумів харчової промисловості, що навчаються за напрямом 6.050502 “Інженерна механіка”.

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Н.Д.Ткаченко,
О. П. Авраменко ,
Є.С. Смірнова, 2009
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ЗАГАЛЬНІ ВІДОМОСТІ

Посібник розрахований на студентів — бакалаврів, магістрів, аспірантів механічних факультетів вузів та технікумів харчової промисловості денної форми навчання. Посібник спрямований на розвиток різних видів мовленнєвої діяльності: читання, перекладу та реферування оригінальної літератури зі спеціальності, говоріння, навичок письма з метою отримання інформації з іноземних джерел, комунікативних навичок в сфері майбутньої професійної діяльності.

Посібник складається з 16 уроків, включає граматичні вправи, спрямовані на повторення і закріплення граматичного матеріалу. Текстовий матеріал охоплює наступну тематику: загальні поняття механіки, явища та закони фізики, машини та механізми, деталі машин, матеріали та їх властивості, обладнання харчових підприємств. У посібнику враховане навчання різним видам читання для пошуку інформації. Посібник містить вправи, спрямовані на розвиток навичок говоріння на професійні теми. Значна увага приділяється вивченню стилю технічної документації.

Посібник передбачає усне та письмове опрацювання матеріалу на практичних заняттях та домашні завдання для самостійної роботи. Завдання націлені на засвоєння лексичного та граматичного матеріалу, готують студентів до монологічного, діалогічного мовлення, зворотнього перекладу. Посібник розрахований на 1 рік навчання.

Посібник враховує структуру матеріалу за модульною системою, Загальноєвропейськими Рекомендаціями з мовної освіти та Програмою з англійської мови для професійного спілкування Британської Ради від 2005 р. Посібник має вивести студентів на рівень B2 +.

THEORETICAL MECHANICS

UNIT 1

1. Learn the notions and their definitions.

Motion momentum the product of mass and velocity.

Force any action that causes the change of the rate or direction or speed of bodies,

Gravitation attraction of the Earth as a result of its rotation around its axis,

Lever a device for lifting loads

Newton The unit of force required to accelerate one kilogram one meter per second per second.

Text 1

2. Read, retell the text and add your own information.

The History of Mechanics

Mechanics studies the conditions of static equilibrium and of the paths of bodies when acted upon by unbalanced forces. The motion of bodies is considered in two ways: *dynamics* is concerned with the causes of motion of real bodies, and *kinematics* deals with the paths of points following specific mathematical laws of motion.

Mechanics began in ancient Greece. In the 4th century B. C. Aristotle created philosophical system in which problems of rest and motion were central, explaining everything by belonging things to their natural places.

After Aristotle in the 3d century B. C. the law of the lever was first explicitly proved by the greatest mathematician of antiquity, Archimedes.

His work, "On Floating Bodies", created the study of *hydrostatics*.

The highest point of kinematical study in antiquity was reached in the 2-d century A.D. by the Greek astronomer Ptolemy. He attempted to represent the real motions of the planets by the system of epicycles in his work "Mathematical Collection".

The medieval work in statics centered on the lever. Earlier, in the 7th century, a Byzantine scholar John Philoponus, proved that the continuing motion of a body after the setting it in motion had ceased.

The Scientific Revolution of the 17th started in 1543 by Nicholas Copernicus's "On the revolution of the Heavenly Orbs" where he gave a reason of earth being at the center and the stars circling it.

Galileo went even further in mechanics to lay the foundations for a new science. Galileo showed that there was only motion under the influence of forces, caused by gravity and a horizontal component created by the thrower. Finally, he showed that distance travelled was directly proportional the square of the time during which the body moves.

The creator of *classical mechanics* was Isaac Newton, who combined the medieval heritage the work of Copernicus, Kepler, and Galileo in a classical synthesis. In his 1689; "Mathematical Principles of Natural Philosophy", Newton put out the basic laws of the new physics. He defined force as the product of mass and acceleration, and presented the principle of the conservation of momentum as a fundamental law. More important, he showed his definitions of force, mass, momentum, all aspects of statics, dynamics, and kinematics could be treated mathematically, inventing the calculus. Newton also provided the necessary mathematical instrument. And with the laws of motion set forth in the "Principia", laid the principle of universal gravitation. He created celestial mechanics.

During the 100 years afterwards, the major progress in mechanics

was its progressive mathematization In 1788, Luis Lagrange published his “Analytical Mechanics”, which treated mechanics as a branch of mathematics. Mechanics also returned to its roots in physics in the 19th century. Andre-Marie Ampere discovered aspects of electrical science that could be treated by mechanical methods and thus founded the science of *electrodynamics*. The *kinetic theory of gases* provided new physical measurements and concepts that could be mathematized and handled by mechanics. Then *statistical* mechanics was born.

Albert Einstein introduced *relativity theory*, which made it impossible to define rest or a straight line, thus destroying Newtonian mechanics in certain crucial areas of physics. Max Planck's suggestion that energy was not continuous but came in little packets provided a whole new perspective for the study of atomic phenomena. In the 1920s a special mechanics called *quantum mechanics* was devised to deal with subatomic particles. This mechanics is completely mathematical, it consists of the mathematical computation of the probability. Newtonian mechanics still holds and serves to direct everything from the design of new automobiles and aircraft to the navigation of intercontinental ballistic missiles and satellites.

Vocabulary

condition	умова
to cause	спричиняти
celestial body	небесне тіло
influence of forces	вплив сил
to create	творити
to provide	забезпечувати
motion	рух
to consider	розглядати, вважати
to belong	належати

to discover	відкривати
lever	важіль
to invent	винаходити
to prove the law	доводити закон
measurement	вимір
to define	визначати
to devise	розробляти
conservation	збереження

3. Complete the sentences.

1. The subject-matter of the text is ____ 2. The text deals with ____ 3. First the author accounts on ____ 4. Then he dwells upon ____ 5. Further on he points out that ____ 6. The author emphasises that ____ 7. The author goes on saying that ____ 8. To continue the author also discusses (mentions, throws light upon, considers the problem of, raises the question of, writes, speaks, tells about) ____ 9. In conclusion the author underlines / states that ____.

4. Answer the questions.

1. What is the history of mechanics based on? 2. How old is the science of mechanics? 3. How much time did it take to develop mechanics? 4. When did mechanics begin to develop intensively? 5. Who are the fathers of mechanics? 6. Who developed mechanics to the level of a science? 7. How's the mechanics of Galileo and Newton called? 8. How was mechanics enriched later on? 9. Where is the classic mechanics applied (used)? 10. Are you mechanically minded? 11. Can everything in the world be treated mechanically?

5. Find in the text the equivalents of the Ukrainian words and

expressions.

доводити вичерпно (ясно), закон важеля, забезпечити виміри, бути пов'язаним з, мати справу з, належати до, досягати точки, шлях тіла, намагатися представити, приводити в дію, наука розглядає, причина руху тіла, припиняти дію, дія сили, дати обґрунтування, основний закон, обробляти, (представляти) математично, висувати положення, створювати (3) теорію, умови рівноваги.

6. Fill in the gaps and learn the abstract by heart.

motion, influence, provide, prove, define, attempt, cease, belong, treat, put out, create, lever, discover, cause, law, force.

Mechanics studies the conditions of static equilibrium and of the paths of bodies when acted upon by unbalanced _____. The _____ of bodies is considered in two ways: dynamics is concerned with the _____ of motion of real bodies, and kinematics deals with the paths of points following specific mathematical _____ of motion. Aristotle explained everything by _____ things to their natural places. The law of the _____ was first explicitly _____ by the greatest mathematician of antiquity, Archimedes. His work, "On Floating Bodies", _____ the study of hydrostatics. The Greek astronomer Ptolemy _____ to represent the real motions of the planets by the system of epicycles in his work "Mathematical Collection". A Byzantine scholar John Philoponus, proved that the continuing motion of a body after setting it in motion had _____. Galileo showed that there was only motion under the _____ of forces, caused by gravity. Newton _____ the basic laws of the new physics. He _____ force as the product of mass and acceleration. Newton also _____ the necessary mathematical instrument. Luis Lagrange _____ mechanics as a branch of mathematics. Andre-Marie Ampere _____ aspects of electrical science that could be treated by

mechanical methods.

7. Match the notions and their definitions and supply examples.

1) motion momentum, force, gravitation, lever.

2) attraction of the Earth as a result of its rotation around its axis, a device for lifting loads, any action that causes the change of the rate or direction or speed of bodies, the product of mass and velocity.

8. Form the nouns denoting object, action, process, or occupation with the suffixes: *-tion, -ing, -er, -or, -ment* to use in definitions.

exploit, construct, produce, train, design, equip, refine, build, educate, operate, make, draw, transmit, educate, develop, apply, count, provide, conclude, convert, transform, compress, transform, to work, to teach, to lecture, to read, to write, to discover, law.

9. Match the verbs and nouns to speak on the scientific achievements of the past and present.

1) provide, state, give, supply, discover, make, invent, develop, consider, achieve, cause, create, prove, argue, take, suggest, deal with, treat.

2) law, theory, discovery, invention, problem, motion, decision, explanation, the facts, machine, reasons, conclusion, measurements, experiments, concept, perspectives, mechanism, results, examples.

10. Group the synonyms.

discover, put out, make, count, reach, device, find out, treat, relate, concern, motion, explain, dynamics, cause, try, calculate, achieve, supply, construct, stop, manufacture, enterprise, attempt, ground, create, provide, build, instrument, graduate, receive, produce, deal with, design, cease, compute.

11 .a) Complete the sentences.

1. Adding numbers we obtain _____. 2. Studying mechanics we master _____. 3. Designing new machines we develop _____. 4. The solution suggested gives grounds for _____. 5. The physical laws applied in practice allows us _____. 6. Treating mechanics mathematically we can _____. 7. Providing the proofs of the theory we must _____. 8. The distance divided by the time allows to obtain _____. 9. Multiplying the average speed by the time, we will obtain _____. Increasing the speed we _____.

b) Express the same idea using the prepositions and conjunctions: when, as, after, if, since, because, that is why, therefore.

12. Discuss the following problems with your groupmates at the young scientists' conference using the given words and expressions.

1. History of mechanics. 2. Branches of mechanics. 3. The most significant achievements of the famous scientists – discoverers and inventors: Korolyov, Tsiolkovsky, Paton, Yablochkov, Popov, Curie, Kovalyevska, Lobachevsky, Nobel, Gagarin, Diesel, Mendeleyev.

agree, exactly so, sure, for sure, to be sure, surely, there is no doubt about it, undoubtedly, certainly, naturally, evidently, it is a proved fact.

disagree, it is quite wrong, It is absolutely the other way out, I doubt it, it may not be so, I object it, it is not true to fact, it is contradictory, it is ungrounded, it requires proofs / grounding

13. Revise the mathematical signs:

1) Read and learn the arithmetic operations.

$a = b$ – a equals to b , $c:d$ – c divided by d , $c + f$ – c added to f ,

$9 \cdot 7 = -9$ multiplied by 7 is (is equal to, equals to, makes, gives) minus 9,

$\frac{1}{3} - \frac{3}{4}$ – three fourths subtracted from one third, a^2 – a squared, a^n

– a to the power of n , $\sqrt[3]{}$ – cube root, 3.68 – 3 point six eight, \sin –

sinus, cos – cosine, $(a + b)$ – in brackets, bracketed, 10% – ten percent, 5° – 5 degrees.

2) Do sums and read them in English.

$13 + 17 =$, $67 + 12 =$, $87 + 113 =$, $520 + 754 =$, $1872 + 25 =$; $1647 - 112 =$, $165 - 15 =$, $18 - 8 =$, $1794 - 152 =$, $88 : 4 =$, $45 : 5 =$, $482 : 2 =$, $1269 : 3 =$, 2, 6, 10, 3, $\sqrt{16}$, $\sqrt{49}$, $\sqrt[3]{8}$, $\sqrt[3]{27}$, $\sqrt[3]{125}$.

3) Ask your groupmates to tell you the multiplication table.

14. Translate the following text into English.

Механіка вивчає найпростішу форму руху матерії – механічний рух. Механічним рухом називають зміни взаємних розміщень тіл або їх частин. Звичайно під механікою, яку тепер називають класичною, розуміють вчення про рухи макроскопічних тіл, швидкості яких малі порівняно з швидкістю світла. В основі її лежать закони механіки Ньютона. Рухи тіл, швидкості яких близькі до швидкості світла, описуються в теорії відносності; рухи мікрочастинок вивчаються в квантовій механіці.

Механіка поділяється на кінематику і динаміку. У кінематиці вивчаються переміщення тіл залежно від часу, без урахування їх маси і сил, що діють на тіла. У динаміці вивчаються рухи тіл під дією прикладених до них сил; сюди відносять також статику – вчення про умови рівноваги тіл.

Завдання механіки полягає у вивченні різних рухів та встановленні їх законів. Останні дають можливість наперед передбачати потрібні рухи й конструювати робочі механізми та машини.

Для встановлення законів руху, звичайно, потрібно врахувати маси тіл, зв'язки між ними та зовнішні діючі сили. Ці завдання розв'язуються в динаміці. Проте перш ніж перейти до розв'язування їх треба розглянути спочатку методи опису рухів. Ці методи вивчає кінематика. Для опису руху тіла користуються аналітичним і графічним методами. При цьому абстрагуються від тіла до матеріальної, точки або

системи матеріальних точок. Положення матеріальної точки в просторі визначається як положення геометричної точки. Під матеріальною точкою розуміють реальний об'єкт нескінченно малих розмірів, що має масу.

Text 2.

1. Read the text to look for the proofs of the Newton's laws.

Newton's Laws of Motion and Equilibrium

In his *Principia*, Newton reduced the basic principles of mechanics to three laws:

1. Every body continues in its state of rest or of uniform motion in a straight line, unless it is compelled to change that state by forces impressed upon it.

2. The change of motion of an object is proportional to the force impressed and is made in the direction of the straight line in which the force is impressed.

3. To every action there is always opposed an equal reaction; or, the mutual actions of two bodies upon each other are always equal and directed to contrary parts.

Newton's first law is a restatement of the principle of inertia, proposed earlier by Galileo and perfected by Descartes. The second law is the most important of the three; it may be understood very nearly to summarize all of classical mechanics. Newton used the word "motion" to mean what is today called momentum — that is, the product of mass and velocity, or $p = mv$, where p is the momentum, m the mass, and v the velocity of a body. The second law may then be written in the form of the equation $F = dp/dt$, where F is the force, the time derivative expresses Newton's "change of

motion." and the vector form of the equation assures that the change is in the same direction as the force, as the second law requires. For a body whose mass does not change,

$$\frac{dp}{dt} = m \frac{dv}{dt} = ma \quad (1)$$

where a is the acceleration. Thus, Newton's second law may be put in the following form:

$$F=ma \quad (2)$$

It is probably fair to say that equation (2) is the most famous equation in all of physics.

Newton's third law assures that when two bodies interact, regardless of the nature of the interaction, they do not produce a net force acting on the two-body system as a whole. Instead, there is an action and reaction pair of equal and opposite forces, each acting on a different body (action and reaction forces never act on the same body). The third law applies whether the bodies in question are at rest, in uniform motion, or in accelerated motion.

If a body has a net force acting on it, it undergoes accelerated motion in accordance with the second law. If there is no net force acting on a body, either because there are no forces at all or because acceleration not to be accelerated may be deduced to have no net force acting on it.

Consider, for example, a massive object resting on a table. The object is known to be acted on by the gravitational force of the Earth: if the table were removed, the object would fall. It follows therefore from the fact that the object does not fall that the table exerts an upward force on the object, equal and opposite to the downward force of gravity. This upward force is not a mere physicist's bookkeeping device but rather a real physical force. The table's surface is slightly deformed by the weight of the object,

causing the surface to exert a force analogous to that exerted by a coiled spring.

It is useful to recall the following distinction: the massive object exerts a downward force on the table that is equal and opposite to the upward force exerted by the table (owing to its deformation) on the object. These two forces are an action and reaction pair operating on different bodies (one on the table, the other on the object) as required by Newton's third law. On the other hand, the upward force exerted on the object by the table is balanced by a downward force exerted on the object by the Earth's gravity. These two equal and opposite forces, acting on the same body, are not related to or by Newton's third law, but they do produce the equilibrium immobile state of the body.

Vocabulary

reduce	скоротити
straight line	пряма лінія
compel	примусити
impress a force	прикладати силу
direct	прямий, спрямовувати
restatement	нова трактовка
put a law	викласти закон
require	вимагати
equation	рівняння
treat, handle	мати справу з
calculate, compute	обчислювати
suggest	пропонувати
design	конструювати
exert a force	спричиняти силу

2. Ask questions on the text.

3. Write the plan of the text

4. Translate the following text into English.

Теоретична механіка ґрунтується на законах І.Ньютона. Тому вона ще називається ньютонівською або класичною механікою. І.Ньютон упровадив поняття про простір і час, дав поняття абсолютного та відносного руху.

Виходячи з потреб механіки Ньютон розробив (незалежно від Г. Лейбніца) диференціальне числення та інтегральне числення.. Велике значення мали також праці Ньютона з алгебри, інтерполяції і геометрії. (1687). В «Математичних началах натуральної філософії» (1687) Ньютон, узагальнивши дослідження Г. Галілея, Й. Кеплера, Р. Декарта, Х. Тьйгенса, Р. Гука, Е. Галлея та свої власні, створив струнку систему земної й небесної механіки, яка лягла в основу всієї класичної фізики. Тут Ньютон дав поняття маси, кількості руху, інерції, сили, прискорення, доцентрової сили; сформулював 3 основні закони руху, а також закон всесвітнього тяжіння, на основі якого розробив теорію руху небесних тіл. За Ньютоном, дві матеріальні частинки взаємно притягуються з силою F , яка прямо пропорційна їхнім масам m_1 і m_2 і обернено пропорційна квадрату віддалі r між ними:

$$F = \gamma (m_1 m_2) / r^2, \quad (1)$$

де γ — гравітаційна стала; сила F спрямована вздовж прямої, що з'єднує ці частинки.

І. Ньютон сформулював три основні закони класичної механіки. (1687), Перший закон (закон інерції): «Усяке тіло утримуватися у своєму стані спокою або прямолінійного і рівномірного руху, доки й оскільки воно не змушується прикладеними силами змінювати цей стан». Другий закон: «Зміна кількості руху пропорційна прикладеній

рушійній силі і відбувається в напрямі тієї прямої, по якій ця сила діє». Третій закон: «Дії завжди відповідає рівна їй і протилежно спрямована протидія, тобто дії двох тіл одного на одне завжди рівні і спрямовані по одній прямій у протилежні сторони».

5. Discuss the following problems with your groupmates, using the introductory and connective words and expressions to develop your idea.

1. Newton's contribution to science. 2. Newton's laws. 3. Evidence of the Newton's laws in nature. 3. The validity and application of Newton's laws in mechanics.

to begin with, first, if, then, after that, to continue, in conclusion, thus, nevertheless, it goes without saying, that; both...and, as far as I can understand, either or, neither nor, consequently, let us consider / imagine / suppose, to define, to prove, to obtain, according to, to solve a problem, as arranged, as follows, as shown, to supply an example, by using, best of all, worst of all, the last but not the least, more than that, the most (the least) significant (important, wonderful, beautiful, unusual, difficult, necessary).

UNIT 2

1. Learn the notions and their definitions.

Pressure The force per unit area.

Work Moving some object by force through a distance

Energy Quantity of work done in a minute of time

Power The capacity of a system or body for doing work

Friction The resistance to the horizontal force applied to the body at rest on the horizontal surface;

Coefficient of Friction The constant ratio of the friction to the force pressing the surfaces together.

Static Friction The resistance to motion between two bodies in contact with each other but at rest.

Sliding Friction The resistance to continued motion when one body has started to move.

Rolling Friction The resistance to motion when one or more bodies

Elasticity The property of bodies of returning, after unloading, to their initial form

Joule An international metric measure of energy; one joule is approximately three-quarters of a foot-pound.

Watt An international metric measure of power equal to one joule per second; 746 watts are equal to one horsepower.

Kilowatt A thousand watts.

Foot-pound Work is usually measured in terms of foot-pounds in the English-speaking countries. One foot-pound is a force of one pound through a distance of one foot in the direction of the force.

2. Read the text to find illustrations of the notions in the title.

Text 1

Statics. Force. Equilibrium. Pressure

An action of one body upon another which changes or tends to change the rate or direction or speed of bodies is called *force*. A force has magnitude, direction, and place of application; when the extent of the place of application is negligible and the force is regarded as applied or concentrated at a point, a line through the point parallel to the direction of the force is the line of action. Any number of forces considered collectively is a system of forces; a system is concurrent or non-concurrent, according

as the lines of action of the forces do or do not intersect in a point, and it is coplanar, or noncoplanar, according as they do or do not lie in a plane. The resultant of a system of forces is equivalent to that system, a resultant includes a single and never more than two forces. The process of determining the resultant is called composition.

A body is formally regarded as *rigid* if the distance between any set of two points in it is always constant. In reality no body is perfectly rigid. When equal and opposite forces are applied to a body, it is always deformed slightly compressed or stretched. The body's own tendency to restore the deformation has the effect of applying counterforces to whatever is applying the forces, thus obeying Newton's third law. Calling a body rigid means that the changes in the dimensions of the body are small enough to be neglected.

If magnitudes, lines of action, and senses of two concurrent forces acting on a rigid body are represented by OA and OB (see Fig.1), then the magnitude, line of action, and sense of the resultant is represented by the diagonal OC of the parallelogram $OBCA$. The points of application of the forces may be anywhere on the body in the lines OA , OB , and OC , or their extensions. If the magnitudes and directions of the concurrent forces are represented by AB and BC (see Fig. 2), then the magnitude and direction of the resultant is represented by the side AC of the triangle ABC .

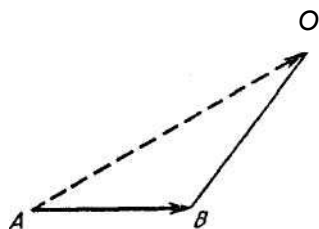


Fig. 2

Fig. 1



Fig. 2

Equilibrium. Statics is the study of bodies and structures that are in equilibrium. For a body to be in equilibrium, there must be no net force acting on it. In addition, there must be no net torque acting on it. The torque on a body due to a given force depends on the reference point chosen, since the torque τ by definition equals $\mathbf{r} \cdot \mathbf{f}$, where \mathbf{r} is a vector from some chosen reference point to the point of application of the force.

Pressure is defined as the force per unit area. Pressure acts equally in all directions. The pressure on the body immersed in liquid is due to the weight of a liquid and may be calculated easily for any depth. Pressure 10·1 or 10 tons is the force with which the one-square-metre column establishes on the bottom of the tank and is, therefore, the pressure in tons per square metre.

Vocabulary

distributed forces	розподілені сили
concurrent	одночасний, співпадаючий
coplanar	в одній площині
determine	визначати
net torque	корисний момент

3. Answer the questions.

1. What is this article about? 2. What is called force? 3. How is the word "pressure" defined? 4. Does pressure act only in one direction? 5. What is pressure caused by? 6. Is pressure associated with gases only? 7. How are the given physical units expressed in letters (abbreviations)? 8. By what formulae (singular — formula) are these physical quantities calculated?

4. Write and retell an abstract of the text using scientific terminology. Use the expressions below.

object (choose, concept), aim (discover, conditions), subject (show,

specifics), material (serve, interacting bodies, liquid), actuality (define, designing and exploitation of mechanisms), concrete tasks (reveal the expressions of the concept, describe the mechanism, model the content of the concept), problems, theoretical significance, practical application, methods (measurements, calculations, logical operations: comparison, reason, consequence), your contribution, the conclusions.

5. Find in the text the equivalents of the Ukrainian words and expressions.

дія тіла на, стан спокою чи руху тіла, паралельно напрямку сили, провести лінію через точку, відноситься до кількох сил, послідовність операцій, на одиницю площини, діяти під прямим кутом до поверхні, математична величина, отримати / перевірити результат, розглядати разом, лінія дії, пересікатися у точці, лежати у площині, сила визначається як, занурене у рідину, завдяки ваги, змінювати порядок, розпочинати.

6. Fill in the gaps.

magnitude, action, extent, application, regarded, refers, determining, intersect, represented, includes.

An ____ of one body upon another which changes or tends to change the state of rest or motion of the body acted upon, is called force. A force has ____, direction, and place of ____; when the ____ of the place of application is negligible and the force is ____ as applied or concentrated at a point. The word "sense" as applied to forces ____ to one of the two directions along the line. Any number of forces considered collectively is a system of forces; a system is concurrent or non-concurrent, according as the lines of action of the forces do or do not ____ in a point. A resultant never ____ more than two forces. The process of ____ the lines of action, and senses of two concurrent forces

acting on a rigid body are ____ by OA and OB.

7. Match the notions and their definitions.

1) force, pressure, work, energy, power, friction, elasticity.

2) the resistance to the horizontal force applied to the body at rest on the horizontal surface; the property of bodies of returning, after unloading, to their initial form; any action that causes the change of the rate or direction or speed of bodies; the capacity of a system or body for doing work; quantity of work done in a minute of time; moving some object by force through a distance; the force per unit area.

8. A. Discuss the following problems in your group using the following words and expressions. Give examples of the objects and phenomena from life.

1. The difference between a rigid body and other bodies. 3. The relation between force and pressure. 4. Equilibrium.

according to / as, it is known that / as, is defined as, is considered as, is formally regarded as, means, is dealt with is treated as, is expressed by, is determined by, is calculated, is required, is called, is referred to as, is represented, is indicated by, is used, with respect to, due to, also, since, therefore, is applied / concentrated at a point, a line through the point, the line of action, number of forces considered collectively, concurrent, non-concurrent, intersect in a point, coplanar, noncoplanar, lie in a plane, the resultant of a system of forces, determine the resultant, is called composition, torque.

B. prepare a drawing or picture of a detail and demonstrate the phenomena described in the text.

9. Form the adjectives with the suffixes *-able*, *-ible* and use them

in the sentences.

Model. If you are able to read the book, the book is readable.

transfer, rely, compare, convert, intersect, apply, change,
allow, count, read, vary, reverse, neglect, prove, admit, solve.

10. Group the synonyms.

magnitude, cross, action, extent, application, regard, refer as,
determine, consider, call, use, intersect, value, define, represented,
length, include.

11. A. Fill in the gaps.

1. We ____ that this property is true. 2. We will ____ the problem.
3. We are ____ the value of this function. 4. We have ____ the equation and
____ the result. 5. We ____ that this set consists a unique element. 6. In order
____ such theorems with the help of axioms we use this result.

a. prove, b. determine c. state, d. calculate, e. suppose, f. consider,
g. check

1. ____ is drawn with two lines. 2. A perpendicular is a ____ line put on
the plane. 3. Circle is drawn as a closed _____. 4. In the ____ of your drawing
you give your name. 5. A ____ angle is less than 90° . 6. A ____ angle is
more than 90° .

a curve, b. obtuse, c. sharp, d. straight, i. angle, f. corner, g. perpendicular.

B. Use exercise A to complete the questions and answer them.

1. Can you ____? 2. May I ____? 3. Why should I ____? 4. What shall I
____? 5. Am I to ____? 6. Let us ____? 7. Are you able to ____? 8. Have I
to ____? 9. Would you, please ____? 10. Will you ____?

12. Word the mathematical symbols using the introductory words

given below.

Let ...be equal to, Let us consider the problem. Let us admit / assume / imagine, suppose, provided, I state / argue that, Let us prove that, according to the expression, proceeding from the given.

1) $a = b$ a equals b or a is equal to b . 2) $a \neq b$ a doesn't equal b or a isn't equal to b . 3) $a \in A$ a belongs to A capital. 4) $A \notin A$ a doesn't belong to A capital. 5) $A \subset B$ A is contained in B . 6) $B \supset A$ B contains A . 7) $A \not\subset B$ A isn't contained in B . 8) $a(B)$ a of B .

13. Fill in the gaps with prepositions. Retell and exemplify the text in Passive Voice.

To give a simple but important example ____ the application ____ statics, consider the two situations shown ____ Figures 3, 4. ____ each case, a mass m is supported ____ two symmetric members, each making an angle ____ respect to the horizontal. ____ Figure 3 the members are ____ tension; in Figure 4 they are ____ compression. In either case, the force acting along each of the members is shown to be equal.

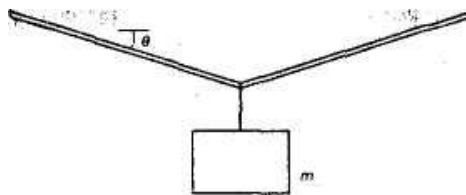


Fig. 3

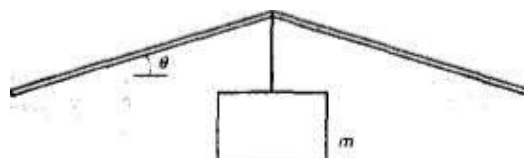


Fig. 4

14. Translate the text into English.

Сила в механіці — міра механічної взаємодії даного тіла з іншими матеріальними об'єктами при безпосередньому контакті (сила *пружності*, сила *тертя* тощо) або через створені ними *фізичні* поля (зокрема, *сила тяжіння*). Джерелами сили є матеріальні об'єкти — тіла або *поля фізичні*. Числове значення сили знаходять за силою, яка врівноважує дану силу (статичний метод), або вираховують, наприклад, за другим законом Ньютона, згідно з яким сила дорівнює добуткові *маси* тіла на *його прискорення* (динамічний метод). Сила характеризується точкою прикладення, напрямком та абсолютною величиною або модулем. Одиницями сили в *Міжнародній системі одиниць* (СІ) є *ньютон*, а в *СТС системі одиниць* — *дина*.

Статика твердого тіла — розділ теоретичної механіки, в якому викладаються методи перетворення одних систем сил в інші, їм еквівалентні, а також вивчаються умови рівноваги систем сил, що діють на тверде тіло.

Сили, які прикладаються до тіла у будь якій його точці називаються *зосередженими*. Сукупність сил, що діють на тіло, називається системою сил. Одну систему сил, що діє на це тіло, можна замінити іншою, то такі системи називаються *еквівалентними*. Якщо система сил еквівалентна одній силі, то така сила називається *рівнодійною*, тобто *врівноважені системи сил*, або системи сил, еквівалентні нулю — це такі системи сил, під дією яких матеріальна точка або тверде тіло перебувають у стані рівноваги відносно інерціальної системи відліку. Зауважимо, що під рівновагою матеріальної точки або твердого тіла розуміють не тільки стан спокою, а й рух за інерцією. Рівномірний прямолінійний рух матеріальної точки є рухом за інерцією. Для твердого тіла існують різні види руху за інерцією, наприклад, рівномірно обертальний рух навколо нерухомої осі. Можна

вважати, що система Декартових координат, жорстко пов'язана із Землею, є інерціальною (абсолютною за І.Ньютоном).

Text 2

1. Read the text for the definitions of the kinds of friction and their cause (what produces friction).

Static and Kinetic Friction

If a block rests upon a horizontal supporting surface, the weight of the block and the resistance of the surface are the two forces acting upon the block. If these distributed forces are considered to be acting at the centre of the area of contact, they may be represented by W and N (Fig. 5 (a)). If a small horizontal force P is applied to the block, and it is still at rest, the force to balance P is the resistance of the supporting plane parallel to P , tangential to the surface, as shown in Fig. 5 (b). This resistance is called friction and is denoted by F .

If the force P is increased gradually, it will reach a certain value that the friction F can no longer balance, and the block will move. While the block is at rest, the friction is called static friction. The highest



Fig. 5

value of the static friction, that when motion is just impending, is called the limiting friction and will be denoted by F' . After motion begins, the friction decreases and is called kinetic friction, or friction of motion. If the block is moving or tending to move over a supporting surface, the friction of the supporting surface is known to be opposite to the direction of the motion.

Adhesion should not be confused with friction. Adhesion is the attraction between two surfaces in contact. It depends upon the areas in contact and is independent of the pressure. Friction is independent of the areas and varies as the pressure. For nearly all problems in engineering, adhesion may be neglected.

If two surfaces in contact are hard and well polished, the frictional resistance becomes very small but never reaches zero. If the friction could reach zero, the surface would be the ideal smooth surface, for which the resistance would be normal to the surface of contact. In some problems in engineering, friction is very small compared with other forces acting and may be neglected in the solution without appreciable error.

Vocabulary

surface	поверхня
increase	збільшувати
vessel	ємність
push	штовхати
transmit	передавати
liquid	рідина
immerse	занурювати
depth	глибина
cross-section	поперічне січення

volume	об'єм
weight	вага
support	підтримувати
block	цеглина
resistance	опір
friction	тертя
adhesion	прилипання
impending	що має відбутися

2. Correct the following wrong statements and give your grounds.

1. Adhesion is dependent on the pressure. 2. When two surfaces in contact are badly polished and so the frictional resistance very easily reaches zero. 3. In solution of engineering problems friction is very important, because it is great compared with the other forces which may be neglected. 4. There is no difference between friction and adhesion. 5. Nothing special would happen if the friction could reach zero.

3. Ask questions on the text.

4. Translate the text into English.

Сили, що виникають у процесі руху одних тіл або їх частин по поверхні інших і істотно впливають на їх відносне переміщення, називаються *силами тертя*. Сили тертя спрямовані тангенціально до взаємодіючих поверхонь, вони можуть виступати в ролі гальмівних і рушійних сил. Тертя спокою виявляється в тому, що для приведення в рух одного з тіл до нього треба прикласти зовнішню силу $F > F_0$ де F_0 — максимальне значення сили тертя спокою. Тертя спокою широко використовується в пасових передачах і фрикційних муфтах для передавання зусиль від одних деталей машин до інших. У транспортних

засобах, між ведучими колесами і трасою, воно виступає в ролі рушійної сили. У випадках руху твердих тіл розрізняють тертя ковзання і тертя кочення. Див. малюнок.

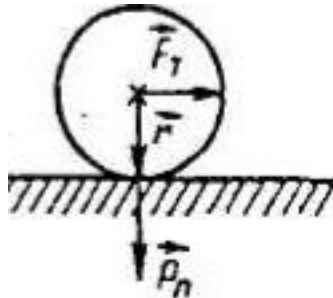


Fig. 6

UNIT 3

1. Learn the notions and their definitions.

Stress resistance to external forces.

Shearing stress the deformation of a body that results from an applied force.

Compressive stress strain caused by equal and opposite pushes F at the ends of the rod.

Tensile stress *normal stress* when the external and internal forces are perpendicular (normal) to the cross-sectional area under consideration.

Strain the deformation of a body that results from an applied force.

Total strain the total change in the size or shape of a body.

Unit strain the total change in the size or shape of the body divided by its original size or shape.

Text 1

2. Analyze the principal notions of the text.

Statics. Strength of Materials

Strength of materials is a branch of engineering that deals with the behavior of materials in response to applied forces. Strength-of-materials data are widely used in designing machinery, buildings, bridges, dams, and other structures. The parts of a bridge, for example, must be strong enough to withstand the various kinds of forces placed on the bridge by traffic, wind, and other agents. These applied forces are resisted by internal forces, called *stresses*, in the beams, columns, cables, and other parts of the bridge, and in the bolted, riveted, or welded joints between parts. As a result, the structural parts are deformed in various ways, including stretching, compressing, shearing, twisting, and bending. Such deformations, or changes of shape, are known as *strains*.

If the stresses and strains in some parts are too great, the parts would break or give way, possibly leading to the collapse of the bridge.

Hence bridge designers rely on strength-of-materials data to specify suitable materials for the various parts of the bridge. High-tensile-strength steel, for example, would be specified for cables, a fatigue-resistant steel for beams and plates subject to repeated flexing, and high-compressive-strength concrete for piers and abutments.

Stress. Stress in a body can be defined as resistance to external forces. It is measured in terms of the force exerted per unit of area. Generally, the force is given in pounds and the resisting area in square inches. Consequently, stress usually is expressed in pounds per square inch (psi). Sometimes it is expressed in kilo-pounds per square inch, which is commonly abbreviated as kips.

Stress is produced in all bodies that are subjected to external forces. The three main kinds of stress are tensile stress, compressive stress, and shearing stress. Other stresses are similar to these basic stresses or are a combination of them. For instance, a bending stress in a beam actually is a combination of tensile, compressive, and shearing stresses.

Tensile Stress. Consider a vertical rod of uniform cross-sectional area A subjected to equal and opposite pulls F at the ends of the rod.

These pulls tend to lengthen the rod, which is said to be in tension. The rod is in equilibrium under the action of the two external forces. Thus a cross section A of the rod is acted on by a downward force equal to the force F exerted by the part of the rod below it and an upward force equal to the force F exerted by the part of the rod above it. The tensile stress at that cross section in the rod is defined as

$$s_t = F/A$$

where s_t is the tensile stress in pounds per square inch, F is the external tensile force (or applied load) in pounds, and A is the stressed cross-sectional area in square inches. A tensile stress is also called a *normal stress* because the external and internal forces are perpendicular (normal) to the cross-sectional area under consideration.

Compressive Stress is caused by equal and opposite pushes F at the ends of the rod. These pushes tend to shorten the rod, which is said to be in compression. The compressive stress in the rod is $s_c = F/A$

Shearing Stress occurs because of the sliding of the above and below layers of the solid. The shearing stress is defined as $s_s = F/A$.

Strain is defined as the deformation of a body that results from an applied force. The deformation may be a change of length, a change of cross-sectional area, a change of volume, or a change of angle as when a rectangular face of a solid is distorted into a parallelogram.

Total strain is the total change in the size or shape of a body. *Unit strain* is the total change in the size or shape of the body divided by its original size or shape. When the term "strain" alone is used, it invariably means unit strain. Each type of stress is associated with a corresponding type of strain.

Notes. inch (дюйм)

psi – pound (фунт) per square inch

kip – kilo-pound per square inch

Vocabulary

strengthen of materials	опір матеріалів
behaviour	поведінка
beam	балка
rivet	заклепка
welded joints	зварні з'єднання
stretch	тягнути
shear	розривати
twist	крутити
bend	згинати
strain	натягнення
give way	піддаватися
collapse	падати
data	інформація
exert force	прикладати силу
concrete	бетон
abutment	опора моста, межа
rod	стрижень

3. Answer the indirect questions on the text. Then make them direct.

1. what the science — the strength of materials deals with? 2. where the

strength-of-materials data are used? 3. what forces act upon the bridge? 4. how the structural parts are deformed? 5. what is the difference between stress and strain? 6. what bridge designers rely upon? 7. where stress is produced? 7. if / whether there is great distinction between tensile, compressive and shearing strain?

4. Find in the text the equivalents of the Ukrainian words and expressions.

опір матеріалів, галузь техніки, займатися чимось, прикладені сили, в конструюванні машин, зварне з'єднання, яка накладається транспортом, опиратися чомусь, зовнішня сила, діючий фактор, називати, елементи конструкції, витримувати напругу, тягнути, під дією, протилежний, поперічне січення, стрижень, в рівновазі, зміни форми, сталь.

5. Fill in the gaps and learn the abstract by heart.

engineering, behavior, designing, withstand, resisted, joints, strains, designers, exerted, shearing,

Strength of materials is a branch of _____. It deals with the _____ of materials in response to applied forces. Strength-of-materials data are widely used in _____ machinery, buildings, and other structures. The parts of a bridge, for example, must be strong enough to _____ the various kinds of forces placed on the bridge by traffic, wind, and other agents. These applied forces are _____ by internal forces, called *stresses* in the bolted, riveted, or welded _____ between parts. Changes of shape, are known as _____. Hence bridge _____ rely on strength-of-materials data to specify suitable materials for the various parts of the bridge. Stress is measured in terms of the force _____ per unit of area. The three main kinds of stress are tensile stress, compressive stress, and _____ stress.

6. Match the notions and their definitions.

1) shearing stress, compressive stress, stress, strain, unit strain, tensile stress, total strain is referred to as / is defined as / is known as / is caused by.

2) resistance to external forces; a *normal stress* when the external and internal forces are perpendicular (normal) to the cross-sectional area under consideration; strain caused by equal and opposite pushes F at the ends of the rod; stress that occurs because of the sliding of the above and below layers of the solid; the total change in the size or shape of a body; the total change in the size or shape of the body divided by its original size or shape; the deformation of a body that results from an applied force.

7. Make up sentences with the negative words using the prefixes *dis-*, *in-*, *un-*.

place, definite, arrange, suitable, usual, stretched, compressed, sheared, twisted, bent, combined, efficient, equal, accurate, expensive, defined, stressed, strained, deformed, connect, divided, variably, loading, elastic.

8. Group the synonyms.

cause, flexible, quality, outside, form, area, internal, deform, use, apply, change, exert, characteristics, constant, formless, stress, square, distort, inside, shapeless, tension, elastic, make, space, shape, external, territory, property, permanent, strain.

9. Explain the following derivatives with the same root denoting a person, object, state, action, process, result, property, phenomenon, science.

mechanic – mechanics – mechanical – mechanically – mechanize – mechanization – mechanism, physics – physical – physicist, apply –

applicable – application – applied – applying, form – formation – deformation – deformed, press – pressing – pressed – pressure – depressed – depression.

10. Ask each other about the characteristics of the physical notions.

Example. Distance is measured in kilometres. Distance is expressed with letter S. This value is obtained by equation_____.

length, width, height, depth, resistance, stress, velocity, tension, voltage, resistance, deformation, pulling, bending, shearing, twisting, stretching, strength, tensile stress, compressive stress, shearing stress, internal force, external force, strain.

11. Make up dialogues on the following topics.

1) The strength of materials, 2) Stresses and strains, their mathematical expression and practical illustrations.

Example. The engineers knew that the machine worked / had worked / would work well.

A. We know that / I wonder if / could / will you tell me / do (would) you mind telling me / I move that / I am sure that / may I ask you / it is a problem if / it is quite clear / it is doubtful whether / it is proved.

B. The speaker said / agreed / assured / objected that / wondered if / proved that / doubted / told us / asked / answered / what / why / how / where / who / when the material was suitable for the detail / machine, the metal proved reliable, the design is being developed now, this detail will wear with time / quickly, clutches are not used there, they applied connectable joints, slight deformation will not influence the machine part, additional loading can cause fracture and damage.

12. Word the mathematical symbols using the introductory

words.

1) $(\forall k \in K) (P(k) \rightarrow Q(k))$ for every k belonging to K capital P of k implies Q of k . 10. 2) $k \in \emptyset$ k doesn't belong to the empty subset of K . 3) $A' \subset A$ the set A prime is contained in the set A . 4) $A \supset A'$ the set A contains the set A prime. 5) $A \cup A'$ the union of A and A prime. 6) $A \cap A'$ the intersection of A and A prime. 7) $A - B$ the difference of A and B .

Text 2

1. Scan the text and give its main idea.

Statics. Elasticity

It may be assumed that a body consists of small particles or molecules, between which forces are acting. These molecular forces resist the change in the form of the body which external forces tend to produce. If such external forces are applied to the body, its particles are displaced and the mutual displacements continue until equilibrium is established between the external and internal forces. It is said in such a case that the body is in a state of deformation or strain. During deformation the external forces acting upon the body do work, and this work is transformed completely or partially into the potential energy of strain. An example of such an accumulation of potential energy in a strained body is the case of a watch spring. If the forces which produced the deformation of the body are now gradually diminished, the body returns wholly or partly to its original shape and during this reversed deformation the potential energy of strain, accumulated in the body, may be recovered in the form of external work.

The property of bodies of returning, after unloading, to their initial form is called elasticity. It is said that the body is perfectly elastic if it

recovers its original shape completely after unloading; it is partially elastic if the deformation, produced by the external forces, does not disappear completely after unloading. In the case of a perfectly elastic body, the work done by the external forces during deformation will be completely transformed into the potential energy of strain. In the case of a partially elastic body, part of the work done by the external forces during deformation will be dissipated in the form of heat which will be developed in the body during non-elastic deformation. Experiments show that such structural materials as steel, wood, and stone may be considered as perfectly elastic within certain limits.

Assuming that the external forces acting upon the structure are known, it is a fundamental problem for the designer to establish such proportions of the members of the structure that it will improve the condition of a perfectly elastic body under all service conditions. Only under such conditions will there be continued reliable service from the structure and no permanent set in its members.

Vocabulary

assume	зробити припущення
external	зовнішній
internal	внутрішній
displacement	зміщення
property	властивість
recover	відновити

2. Try to explain and prove why it is a problem for the designer to improve the condition of a perfectly elastic body under all service conditions.

3. Organize an international conference on the properties of

materials and problems of designers dealing with them. Use interpreters.

it may be assumed that, assuming that, assumed that, under the assumption that, if, suppose if, if we consider, under consideration, in case, in such a case, then, provided that, it is said that, so, thus, though, therefore.

4. Introduce your questions about the mathematical notions below with:

can / could you / are you able to / may / might / allow me / must / we have to / we are to / we should / shall I / we ought to / I dare say / will you / would you

1) the given, 2) the conditions, 3) the ways to solve the problem given above / to find different values, 4) the results of the calculations.

5. Describe: a drawing, figure, scheme, project or design.

the drawing shows, side view, back view, front view, cross section, circle, straight line, the distance, as is shown at the figure, drop a perpendicular, pyramid base, slant height, base area, surface area, solve a problem, obtain a result, given below, find a solution to / of the problem (calculate the volume, mathematical value), carry out calculations, rearrange the expression, sine, cosine, tangence, cotangens, triangle, pyramid, parallelogram, parallelepiped, rectangle, cone, cube, circle, oval, cylinder.

7. Translate the following text into English

Наука про опір матеріалів. Об'єкти вивчення

Опором матеріалів називають науку про інженерні методи розрахунків на міцність, жорсткість і стійкість елементів машин та споруд. У процесі експлуатації машин та споруд їхні елементи (стрижні, балки, пластини, болти, заклепки тощо) так чи інакше беруть участь у

роботі конструкції й зазнають дії різних сил — навантажень. Для забезпечення нормальної роботи конструкція має задовольняти необхідні умови міцності, жорсткості та стійкості.

Під *міцністю* розуміють здатність конструкції, її частин та деталей витримувати певне навантаження не руйнуючись. *Жорсткість* — це здатність конструкції та її елементів протистояти деформуванню (змінюванню форми і розмірів) під дією зовнішніх навантажень. При заданих навантаженнях деформації не повинні перевищувати певного значення, встановленого відповідно до вимог, що ставляться до конструкції: *Стійкістю* називають здатність конструкції або її елементів зберігати певну початкову форму пружної рівноваги.

За результатами досліджень будують цільові діаграми “напруження — деформації”, встановлюють границі текучості, міцності і характеристики пружності матеріалу, що дає змогу визначати найбільш напружені зони у розрахунковому елементі, його деформації і *переміщення*. Порівнюючи за допомогою цільових діаграм розрахункові величини напружень і деформацій з допустимими, визначають на стадії проектування або перевірки розміри і форму конструктивних елементів, які мають забезпечити надійну й економічну експлуатацію споруди (машини).

UNIT 4

1. Learn the notions and their definitions.

Kinematics A branch of the science of mechanics that deals with aspects of motion apart from considerations of mass and force.

Vectors directional quantities.

Scalars denotes the physical quantities that have no idea of direction associated with them.

The position vector the directed segment on the "x-axis".

Coordinate numbers attached to or coordinated with a geometrical object and characterizing this object completely.

Horse-power a unit for measuring the amount of work performed per second.

Joule An international metric measure of energy; one joule is approximately three-quarters of a foot-pound.

Watt An international metric measure of power equal to one joule per second; 746 watts are equal to one horsepower.

Kilowatt: A thousand watts.

Text 1

2. Read and sum up the text simplifying and compressing the difficult sentences.

Kinematics. Vectors and Scalars

The equations of mechanics are typically written in terms of Cartesian coordinates. At a certain time t , the position of a particle may be specified by giving its coordinates $x(t)$, $y(t)$, and $z(t)$ in a particular Cartesian frame of reference. However, a different observer of the same particle might choose a differently oriented set of mutually perpendicular axes, say, x' , y' , and z' . The motion of the particle is then described by the first observer in terms of the rate of change of $x(t)$, $y(t)$, and $z(t)$, while the second observer would discuss the rates of change of $x'(t)$, $y'(t)$, and $z'(t)$. That is, both observers see the same particle executing the same motion and obeying the same laws, but they describe the situation with different equations. This awkward situation may be avoided by means of a mathematical construction called a vector.

A *vector* is a quantity that has both magnitude and direction. It is typically represented symbolically by an arrow in the proper direction, whose length is proportional to the magnitude of the vector. Although a vector has magnitude and direction, it does not have position. A vector is not altered if it is displaced parallel to itself as long as its length is not changed.

By contrast to a vector, an ordinary quantity having magnitude but not direction is known as a *scalar*. In printed works vectors are often represented by boldface letters such as \mathbf{A} or \mathbf{X} , and scalars are represented by lightface letters, A or X . The magnitude of a vector, denoted $|\mathbf{A}|$, is itself a scalar— i.e., $|\mathbf{A}| = A$.

Mathematical operations: addition, subtraction, three kinds of multiplication, and differentiation can be performed with vectors. If vector \mathbf{A} is added to vector \mathbf{B} , the result is another vector, \mathbf{C} , written $\mathbf{A} + \mathbf{B} = \mathbf{C}$. The operation is performed by displacing \mathbf{B} so that it begins where \mathbf{A} ends, as shown in Figure 6 by arrows. \mathbf{C} is then the vector that starts where \mathbf{A} begins and ends where \mathbf{B} ends.

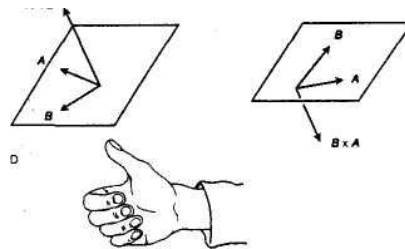


Fig. 7. The right-hand rule used to find the direction of $\mathbf{A} \times \mathbf{B}$ and (right) the right-hand rule used to find the direction of $\mathbf{B} \times \mathbf{A}$. By the right-hand rule: if the fingers of the right hand are made to rotate from \mathbf{A} through \emptyset to \mathbf{B} , the thumb points in the direction of $\mathbf{A} \times \mathbf{B}$, as shown in the figure.

Vocabulary

in terms

в термінах

awkward

незграбний

avoid	запобігати
by means of	засобом
obey to the law	підкорятися закону
magnitude	величина
axes	вісь
observe	спостерігати
alter	змінювати
displace	зміщувати
finger	палець
the thumb points	великий палець вказує
the right-hand rule	правило правої руки
rotate	обертатися
arrow	стріла

3. State if the following sentences are true to fact or false. Prove your point of view. Use the words.

right, so it is, absolutely wrong, I object, (dis)agree, true to fact, quite on the contrary, (not) correct, it may be so, (im)possible, it can('t) be so because, unreal, according to, it is generally known that, the fact is, the thing is that, as far as I know, I am sure that.

1. All physical quantities are directional. 2. Directional quantities are called scalars. 3. The length of the arrow is a measure of the magnitude of the vector, the direction of the arrow indicate its direction. 4. The direction of the road must not be taken into account. 5. The ordinary rules of arithmetic are not applicable to vectors. 6. The resultant force will be one kilogram in the direction towards Peter. 7. The length of the diagonal is obtained by the Newton equation. 8. To find the resultant force graphically it is not necessary to complete the parallelogram.

4. Find in the text the equivalents of the Ukrainian words and expressions.

за допомогою стрілочок, вказувати напрям, система координат, величина, рівняння, позначати. підлягати закону, спостерігач, зміщувати, правило правої руки, вказувати у напрямку, взаємно перпендикулярний, виконувати дію, виконувати рух, можна запобігати, виконувати математичну дію.

5. Fill in the gaps and learn the abstract by heart.

quantities, arrow, magnitude, direction, straight, applicable, resultant, measure, torque, counterforces, obeying, rigid, dimensions, neglect, tension, support.

Some physical ____ have no idea of direction associated with them. One can represent these vector quantities graphically by means of _____. The length of the arrow is a measure of the ____ of the vector, the direction of the arrow indicate its _____. Suppose we walk two kilometres along a ____ road. Thus, the ordinary rules of arithmetic are not ____ to vectors. Two separate forces of 3 and 4 kg act on it at right angles. In any case, to find the ____ force graphically it is necessary to complete the parallelogram and ____ the length of the diagonal. For a body to be in equilibrium, there must be no net ____ acting on it. The body's own tendency is to restore the deformation has the effect of applying _____, thus _____ Newton's third law. Calling a body ____ means that the changes in the ____ of the body are small enough to be neglected, even though the force produced by the deformation may not be _____. A suspension bridge illustrates the use of _____. The weight of the span and any traffic on it is _____ by cables.

6. Group the synonyms and use them in situations.

straight, general, usual, complete, apply, draw, make, single, different, point, strength, call, magnitude, mean, value, total, equal, way, dot, one,

magnitude, use, direct, the same, cause, quantity, name, finish, ordinary, guess, consider, regard, common, force, pull, various, road.

7. Group the antonyms and use them in situations.

ordinary, increase, straight, parallelogram, sharp, equal, difficult, general, close, win, easy, long, curved, lose, obtuse, rectangle, far, concrete, unusual, short, unequal, decrease.

8. Complete the sentences using the suffixes *-tion, -cian, -less, -ful, -able* with the words in bold.

1. If you can **use** an object it is called _____. 2. If you are unable to **use** it, so it may be _____ for you. 3. If you **move** the process is called _____. 4. If you can **solve** the problem, then it is _____. 5. Something that has no **shape** is called _____. 6. Those who have **power** are _____. 7. Problems dealing with **mathematics** are _____. 8. A person who teaches **mathematics** is _____.

9. Fill in the prepositions and conjunctions. Explain and exemplify the terms 'rectilinear motion' and 'curvilinear motion'.

The two kinds of motion most commonly considered are rectilinear motion and curvilinear motion. _____ the term implies, rectilinear motion _____ a particle is motion along a straight line. Curvilinear motion is motion _____ a curved path. If a particle has rectilinear motion _____ respect to some point _____ is assumed to be fixed, its displacement is its total change of position _____ any given interval of time. Displacement is independent of the path traversed and depends only _____ the initial _____ final position of the particle. It is a vector quantity and is represented graphically _____ a vector.

10. Word and translate the mathematical expressions.

1) $C_A B$ the complement of B with respect to A . 2) $A \cap B$ the set A

is a subset of the union of A and B . 3) $A \cap B$ A the intersection of A and B is a subset of A . 4) $(A \times B) \cup (A' \times B')$ the union of the product of A and B , and, the product of A prime and B prime. 5) The mapping $A \rightarrow X \rightarrow A$ of $B(A)$ into itself. The mapping which establishes a correspondence between A and $X \rightarrow A$ is the mapping of the set of subsets of A into itself.

11. Use participles to compress the prepositional groups.

the plant for building machines, the ship for assembling (welding), the process under control, the device for measurement, the problem under study, the building under construction, the mechanism for lifting, in accordance with, the force that results, the string that is being stretched, the problem that is being solved.

12. Discuss the following topics. Use the words below.

1. Difference between vectors and scalars. 2. The main divisions of physics. 3. The main divisions of mathematics. 4. The main physical notions. 5. The main mathematical notions, expressions, problems.

however, while, that is, by contrast, in particular, in general, is observed / described / represented / performed.

13. Translate the text into English.

Кінематика – це розділ теоретичної механіки, в якому вивчається механічний рух матеріальних об'єктів безвідносно до причин, які його викликають. Механічний рух – зміна взаємного розташування тіл (або їх частин) у просторі з часом. Механічний рух є однією з найпростіших форм руху. Мірою механічного руху є кінетична енергія (скаляр) та імпульс (вектор). Механічний рух, як і всі рухи в природі, підпорядкований закону збереження і перетворення енергії.

З визначення кінематики випливає, що у ній повністю відсутні такі фізичні поняття, як сила її маси, а вивчаються лише загальні

геометричні характеристики руху, наприклад траєкторія, швидкість та прискорення, які належать руху будь-яких об'єктів – молекули, небесного тіла, зображення на екрані монітора та ін.

Механічний рух матеріальних об'єктів відбувається у просторі і розглядається як абсолютний, евклідовий, тривимірний, однорідний та ізотропний, а час – як абсолютний арифметизований. На підставі таких уявлень про простір і час впроваджується понятіи *системи відліку* – сукупності тіл відліку, *системи координат осей та годинника*. Системи відліку можуть бути або нерухомими відносно деякої однієї системи, яка приймається за абсолютну, або рухатися довільно відносно неї. Час як вперервна змінна величина розглядається як незалежна змінна (аргумент).

Відповідно до моделей матеріальних тіл та завдань кінематика поділяється на три частини: *кінематика точки, кіпемшпиич тіла та кінематика суцільного середовища*.

Text 2

1. Read and retell the text.

Dynamics.The Motion of Rigid Bodies

A rigid body is a system of particles that always have a fixed relation to each other.

The motion of a rigid body is said to be rectilinear translation if the motion of each particle of the body is along a straight line and parallel to the line of motion of each of the other particles of the body. The motion of any particle of the body is considered to represent the motion of the entire rigid body, the entire rigid body may be treated as a particle having the same position and motion as the

centre of gravity of the body. The motion of the body of a railway car along a straight track or the motion of a hammer of a pile driver are all examples of rectilinear translation.

In general, any particle of a body considered free has a system of forces acting upon it. Some of them may be considered external to the body as a whole, and some of which are internal. The resultant of all these forces for the particle is called the *effective force* for the particle and is equal to $dM \cdot a$, dM being the mass of the particle and a its acceleration. If the particles of the body were all made free of each other, and each had its effective force acting, the motion of the system of particles would be the same as the actual motion of the body. The resultant of all these effective forces for all the particles of the body is called the *resultant effective force* of the body. Since the internal forces between the particles of a rigid body are always mutual, that is, equal and opposite, their total resultant for the whole body is assumed to be equal to zero. It follows, then, that the *resultant effective force* for all the particles of a rigid body must be equivalent to the resultant of the *external forces*.

Since each particle has a force equivalent to $dM \cdot a$ acting upon it, and since each force is proportional to the mass of the particle, the point of application of the resultant is necessarily the same as that of a system of particles acted upon by their own weights.

The velocity of a particle with rectilinear motion is the time rate of its displacement from some assumed point of reference. If the particle traverses equal spaces in equal time intervals, its velocity is uniform, and the amount of its velocity is equal to the ratio of the given displacement to the time in which the displacement was made. If s is the displacement and t the time, the amount of the velocity v is given by the equation

$$v = s \cdot t$$

Vocabulary

rigid body	нерухоме тіло
rectilinear translation	прямолінійний поступальний рух
along a straight line	вздовж прямої лінії
application	застосування
external	зовнішній
acceleration	прискорення

2. Explain the difference between the resultant force and resultant effective force of the body. Why are these notions important in mechanics?

3. Match the notions and their definitions.

1) power, energy, horse-power, work, force, distance.

2) a unit for measuring the amount of work performed per second; the quantity of work done in a unit of time; rate of performing the work; the capacity for work. watts, kilowatts, and kilogram-metres per second; measure of space between two points, places, etc.

4. Translate the text into English.

Динаміка (від грец. динамікос, – сильний) – розділ *механіки*, який вивчає рух матеріальних тіл залежно від прикладених до них сил. Залежно від властивостей об'єкта, рух якого вивчають, динаміку поділяють на динаміку матеріальної точки, динаміку системи матеріальних точок, динаміку тіла змінної маси, динаміку пружного і пластичного деформованого тіла, динаміку рідин і газів.

Основні закони динаміки сформулював І. Ньютон (1686). Рух матеріальних точок і систем у динаміці досліджують за допомогою *диференціальних рівнянь* руху, які в загальному випадку можна

отримати на основі законів Ньютона, або за допомогою *варіаційних принципів механіки*. Розв'язування окремих задач динаміки спрощується використанням загальних теорем динаміки, які встановлюють залежність між характеристиками або мірами руху і мірами діяння сил.

Динаміка машин і механізмів — галузь знань про рух машин і механізмів з урахуванням сил, що діють на них; розділ *машин і механізмів теорії*. Основні задачі динаміки машин і механізмів: вивчення впливу зовнішніх сил, сил тяжіння, сил *тертя* та сил *інерції* на ланки машини (механізму) і встановлення способів зменшення динамічних навантажень, що виникають під час їхнього руху; вивчення режимів руху машин і механізмів під впливом сил, прикладених до їхніх ланок, і встановлення способів, що забезпечують потрібні режими руху.

Динаміка машин і механізмів пов'язана з *опором матеріалів*, теорією *пружності*, теорією *коливань*, аналітичною *механікою* та ін.

5. Discuss in your speaking group the problems of the rigid bodies in life and in production.

Text 3

1. Tell what you know about the key notions in the title. Read the text and show the interrelation between the key notions.

Work. Power. Energy

When the point of application of a force moves, so that the force has a component along the displacement of its application point, the force is said to do *work*. If the force is assumed to be constant in

magnitude and in direction and the displacement to be straight, then to determine the magnitude of the work one should multiply the component of the force along the displacement and the displacement; if this component is in the direction of the displacement, the work is regarded as positive; if opposite, the work is negative. The unit of work depends on the units used for force and distance.

Considering *power* requires considering the rate of performing the work. For example, if a weight is lifted at height of one metre in one second, twice as much power will be required than in case that very weight were lifted to a height of one metre in two seconds.

Measuring power, we generally use such units as watts, kilowatts, and kilogram-metres per second. Seventy five kg. m. s. (kilogram-metres per second) or 736 W (watts) form a horse-power. A horse-power is a unit for measuring the amount of work performed per second. Power is the quantity of work done in a unit of time. Energy is the capacity for work.

After the conversion of work into heat, or chemical energy into work or into electrical energy, the actual amount of energy is the same as before the change. In other words, when energy is spent, there is still as much energy as before. This fact which is one of the fundamentals of physics is known as the Law of the Conservation and Transformation of Energy.

Vocabulary

displacement	зміщення
uniform	однорідний
conversion	перехід
conservation	збереження

2. Translate the text into English.

Енергія – міра руху у всіх матеріальних процесах і видах

взаємодій. Встановлено, що всі форми руху матерії здатні перетворюватися одна на одну в певних кількостних співвідношеннях. Залежно від форм фізичних процесів розрізняють такі види енергії: механічну, теплову, хімічну, електромагнітну, ядерну, гравітаційну та ін. При будь-яких процесах, що відображаються у замкнутій системі, використовується закон збереження і перетворення енергії. Теорія відносності встановлює зв'язок енергії будь-якого матеріального об'єкта з його масою m : $E = mc^2$, де c швидкість світла у вакуумі. У міжнародній системі одиниць (СИ) енергію вимірюють у джоулях, у СГС – системі в ергах, Позасистемною одиницею енергії є електровольт.

Робота у фізиці — фізична величина, що характеризує перетворення енергії одного виду на інший, яке відбувається в даній фізичній системі. В механіці робота є мірою дії сили і залежить від величини, напряду цієї сили та переміщення точки її прикладання. Робота та теплота являють собою єдині можливі форми передачі руху від одного тіла до іншого. Теплота – це форма передачі енергії, яка являє собою сукупність мікрофізичних процесів (обмін енергіями при сутичці молекул, випромінювання квантів світла, т. п.),

При русі механічної системи сума роботи усіх діючих сил на деякому переміщенні дорівнює зміні *кінетичної енергії* T цієї системи: $\Delta T = T_2 - T_1$. У випадку потенціальних сил робота не залежить від виду траєкторії точок прикладання сил і визначається лише значеннями *потенціальної енергії* Π початкового Π_1 та кінцевого Π_2 положень системи: $A = \Pi_1 - \Pi_2$. В *Міжнародній системі одиниць* (СИ) роботу вимірюють у джоулях. Робота тіла дорівнює різниці енергії до переходу в іншу форму та її залишку після цього.

3. 1) Discuss in your group the examples of work, power, and energy and the units of their measurement. 2) State and prove the Law of the Conservation and Transformation of Energy.

THE THEORY OF MACHINES AND MECHANISMS

UNIT 5

1. Learn the notions and their definitions.

Simple machine A device that changes the direction or magnitude, or both, of an applied force and thus do useful work.

Linkage A mechanism consisting of rolls connected to each other by joints that permit motion.

Wheel and Axle A basic machine consisting of a wheel that rotates on a shaft called the axle.

Spring An elastic material that returns to its original shape after being forced out of that shape.

Inclined plane Flat surface that slants or slopes

Wedge Two inclined planes joined together

Screw An inclined plane wrapped around a cylinder

Crank A bent shaft or arm for transmitting motion or changing from rotary to reciprocating motion and vice versa.

Pulley A basic machine consisting of a wheel with a grooved rim through which a rope, wire, or chain is passed.

Block A pulley contained in a housing; the combination of a fixed and a movable block together with a rope is known as a *block and tackle*.

Helix The corkscrew-shaped figure that results from wrapping the line of an inclined plane around a cylinder; the plural is *helices*.

Jack A device used to raise heavy weights for short distances.

Lever A basic machine consisting of a rigid piece or bar that turns on a point.

Fulcrum The point on which a lever turns.

Text 1

2. Look through the text for the problems described. Exemplify them using your experience. Translate and retell the text.

Simple Machines

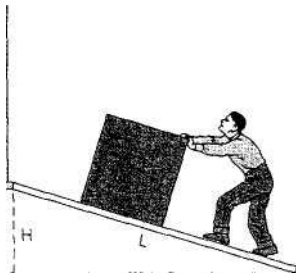
The term simple machine is often used to identify those devices that change the direction or magnitude, or both, of an applied force and thus do useful work. Among the simple machines are the lever; wheel-and-axle; inclined plane, wedge, screw, and pulley.

Linkage. Machines are often classified by the arrangement of their linkage systems. For example, an internal-combustion engine may be described by a four-link system called a *slider crank*. Another four-link system is the *four-bar linkage*. The punch press is an example of a slightly more complicated device that combines the slider crank and the four-bar linkage into a six-bar arrangement.

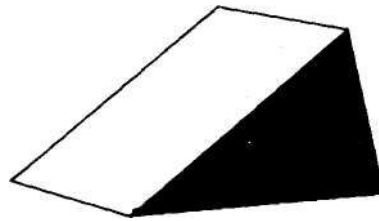
Most simple machines operate in a single plane or in a series of parallel planes and have an output motion that is rotational, translational, or a combination of the two. The four-bar linkage illustrates the use of a crank for both input and output motions. Depending on the configuration of the links, the four-bar linkage with a constant rotational input motion can have an oscillating, identical, or nonuniform output motion

Inclined Plane. The inclined plane is an example of a simple machine that exchanges increased distance for less effort. An inclined plane is a flat surface that slants or slopes. If two inclined planes are joined together, they

form the simple machine called a *wedge*. Wedges are very helpful in cutting and splitting things. Knives, axes, and our front teeth are good examples of wedges.



An inclined plane



A wedge.

Fig 8.

The inclined plane has various applications, (a) When used as a loading ramp for a truck, the inclined plane has a mechanical advantage equal to L/H , where L is the length of the ramp and H is the height of the truck's tailgate above the ground, (b) A wedge is equivalent to two inclined planes joined together. A downward force is transformed into sideward forces, useful for splitting things, (c) If an inclined plane is wrapped around a cylinder, we have a simple machine known as a *screw*. A screw-type automobile jack is an example of this machine.

The simplest pulley is called a *fixed pulley*. A single pulley at the top of a flagpole is a good example. Ideally, omitting friction, this pulley has an MA of 1—that is, our force is not multiplied; only its direction is changed. A downward pull on the rope sends the flag up the pole. It is easier to pull down than to pull up; gravity works with our body weight to make this easier.

A second kind of pulley is called a *movable pulley*. This kind moves along with the weight. In a movable pulley, a support above gives the added effort. So pulling upward on a movable pulley results in lifting an object with



Fig. 9

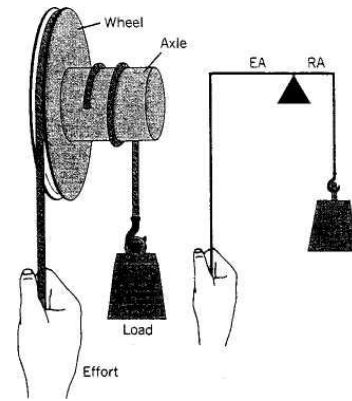


Fig. 10

only half the effort (neglecting friction), but the object rises only half the distance pulled. The reason is that to lift the object 1 foot, we must pull up 1 foot on the effort side and take up 1 foot of slack on the supported side.

Vocabulary

device	пристрій
alter	міняти
predetermined	завданий
lever	важіль
wheel-and-axle	ворот
inclined plane	нахилена поверхня
loading ramp	вантажний скат
truck	вантажна машина
wedge	клин
screw	гвинт
pulley	блок
slider crank	повзун
four-bar linkage	чотириланкова передача

3. Ask questions on the text.

4. Find in the text the equivalents of the Ukrainian words and

expressions.

пристрій для виконання корисної роботи, складатися з комбінацій жорстких ланок, застосування сил, серед найпростіших машин, устрій системи з'єднань, може бути описана, більш складний пристрій, працювати в одній площині, продуктивний рух, пласка поверхня, утворювати клин, технічна перевага важіля, бокова сила, рухомий блок, додане зусилля, піднімати об'єкт, відомий як гвинт, причина в тому, спричиняти обертання кривошипу, передавати обертальний рух.

5.Fill in the gaps.

producing, composed, formed, identify, applied, inclined, arrangement, described, combines, operate, exchanges, slants, support.

Machine is device for ____ useful work, ____ of combinations of rigid or resistant links ____ and connected in order to alter, transmit, and direct the application of forces in a predetermined way. The term simple machine is often used to ____ those devices that change the direction or magnitude, or both, of an ____ force and thus do useful work. Among the simple machines is ____ plane. Machines are often classified by the ____ of their linkage systems. For example, an internal-combustion engine may be ____ by a four-link system called a *slider crank*. The punch press is an example of a slightly more complicated device that ____ the slider crank and the four-bar linkage into a six-bar arrangement. Most simple machines ____ in a single plane or in a series of parallel planes. Inclined Plane. The inclined plane is an example of a simple machine that ____ increased distance for less effort. An inclined plane is a flat surface that ____ or slopes. In a movable pulley, a ____ above gives the added effort.

6. Match the notions and their definitions.

1) inclined plane, slider crank, wedge, screw; movable pulley.

2) two inclined planes joined together; inclined plane wrapped around a cylinder; flat surface that slants or slopes; pulley that moves along with the weight; four-link system.

7. Discuss the words: explain the words with the same root denoting an object, process, action, property, direction, result, etc.

downward – upward – sideward, put – input – output, complicated – complex, direct – direction, arrange – arrangement, combine – combination – translate – translation – translator, transform – transformation, rotate – rotary – rotation – rotor, link – linkage – linked.

8. Use the synonyms in situations.

slant, slope, inclination; neglect, omit; lift, raise; machine, device; use, application; linkage, connection; combined, complicated, complex; transmit, translate, deliver.

9. Insert the prepositions wherever necessary.

1. Thermodynamics deals ____ the conversion ____ mechanical energy ____ thermal energy. 2. The production ____ heat ____ mechanical means may be illustrated ____ the phenomenon ____ friction. 3. A heat engine is a machine ____ transforming heat ____ mechanical energy. 4. To transform energy ____ any ____ its numerous forms ____ heat is a comparatively simple process. 5. ____ the case ____ the ideal reversible process, there is no change ____ the quantity ____ available energy. 6. No change ____ a system ____ bodies that takes place ____ itself can increase the available energy ____ the system.

10. Make up dialogues on the following topics using the

introductory and connective words.

1. The definition of machine. 2. The arrangement of the simplest machines. 3. The mechanical laws underlying the operation of the simplest machines. 4. The simplest machines applications.

the reason is, in order to, depending on, because, concerning, that is why, hence, thus, so, therefore, since, if...then, taking into consideration that, proceeding from the fact that, first...then, after that, it can be viewed, the reason / thing is.

11. a) Consider the Linear Equations and tell whatever you studied on the topic.

Equations in which the highest power of the variables is the first, are called equations of the *first degree*. Thus, $y = 3x + 5$, $y = 2 - 7x$ and $y = 0.3x - 0.5$ are all equations of the first degree. All equations of this type give graphs which are straight lines and hence they are often called *linear equations*.

12. Translate the text into English.

Блок

Блок (англ. block, нім. Block, франц. bloc) — 1) Механізм у формі колеса з жолобом по ободу, через яке перекинута канат (трос, ланцюг). 2) Сукупність вузлів, пристроїв, споруд або яких небудь частин (деталей), об'єднаних за призначенням, розміщенням тощо (турбінний блок електростанції, блок харчування). 3) Вузол машини з кількох однакових частин, наприклад, блок циліндрів у двигуні внутрішнього згоряння. Комбінація нерухомого та рухомого колес називається блок і трос (таль, поліспаст), робить блок більш зручною, простішою машиною. Нижнє чи рухоме колесо збільшує нашу силу вдвічі (незважаючи на тертя), а верхнє

або фіксоване колесо змінює напрямок сили.

Text 2

1. Read and retell the text.

The Lever

The lever is a bar with a support, called a *fulcrum*. A lever can increase the applied force, as in a crowbar or the use of a hammer to pry up nails; or it can increase the speed or distance of a force, as in a baseball bat or fishing pole. But it cannot increase the force and the speed at the same time; it may do only one of these things. Compound machines are merely arrangements of two or more simple machines.

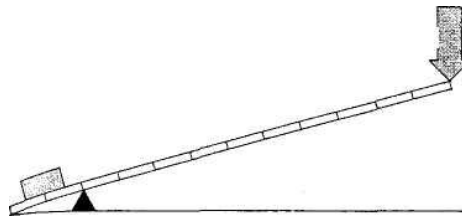


Fig. 11. In order to raise the load of 120 pounds located at 1 foot from the fulcrum, an effort of 12 pounds is needed at 10 feet from the fulcrum.

Mechanical Advantage. A beam balance, which is a kind of lever. At a distance 6 units to the left of the fulcrum, a double weight is hanging. Suppose we wish to balance this weight by hanging a single weight on the right. At what distance from the fulcrum must we hang the weight? Experiment would quickly show that this distance is 12 units. By performing more experiments of this sort we would find that, in all cases, the weight on the left times its distance from the fulcrum equals the weight on the right times its distance from the fulcrum. (In this case, $2 \times 6 = 1 \times 12$).

The number of times a machine increases the applied force is called the

mechanical advantage (MA) of the machine. It can be found by dividing the resistance (*R*), which is the weight of the object moved, by the effort (*E*), which is the force applied. So if a 120-pound rock is moved by a 12-pound force, the MA is 10:

$$\frac{R}{E} = \frac{120\text{lbs}}{12\text{lbs}} = 10$$

There is another, equally simple, way to compute the MA. The distance from the fulcrum to where the effort is exerted is called the *effort arm* (EA), and the distance from the fulcrum to where the resistance is exerted is called the *resistance arm* (RA). The MA is computed by dividing the EA by the RA. For example, in Figure 1 the EA is 12 feet and the RA is 6 feet; the MA is therefore 12/6, or 2. In Figure 2 the EA is 10 feet, the RA is 1 foot, and the MA is 10.

Distance vs. Effort. It should be pointed out, however, that we are not getting something for nothing. In Figure 2, although we exert only 12 pounds of force to raise a 120-pound load, our 12-pound force has to move through a greater distance than the load. For example, if we push the end of the lever down one foot, the load will be raised only about one inch.

In physics, work is defined as the product of a force and the distance through which the force is exerted. A common unit of work in English units is the foot-pound, equal to the work done by a force of one pound exerted through a distance of one foot; and the basic metric unit of work is the joule, equal to a force of one newton exerted through a distance of one meter. In the example above, if we push the end of the lever down by one foot, we have put in 1 foot x 12 pounds, or 12 foot-pounds, of work. If the load is raised one inch, then the work done on the load is 1/12 foot x 12 pounds, or again 12 footpounds.

Vocabulary

crowbar	балка
fulcrum	центр шарніра

hammer	молоток
pry up nails	забивати гвозді
hang	висіти
beem balance	балансна балка
set of rollers	набір роликів
roundness	окружність
taper angle	кут різблення
adjustable gauge	регульований
top blade	верхнє ребро
touch	торкатися
force exerted	сила, яка діє

2. Ask questions on the text

3. Calculate the mechanical advantage of any machine.

4. Translate the text into English.

Важіль

Важіль – простіша машина, зазвичай складається з прямого міцного стрижня, кій вільно обертається навколо зафіксованої точки, яка називається точкою опори (точкою прикладення сили, обертання, вісью шарніра), під дією двох чи більше сил, яки нерідко називаються прикладеною та опірною силами. Первинне призначення важеля – збільшити силу та рух. Хоча важіль не може зекономити роботу, він полегшує її виконання. Відомі приклади важелей включають лом, кліщі та кістки рук та ніг.

Помножене усилля, отримане від важеля, чи відношення кінцевої сили до прикладеної, називається механічною перевагою. Наприклад,

якщо сила у 100 фунтів дозволяє рухати вантаж вагою у 1000 фунтів, то механічна перевага складає 10. Тертя в цьому обчисленні ігнорується, тому що, навіть якщо воно присутнє, воно, як правило, є таким незначним, що воно суттєво не впливає на результат. Тим не менше, нерідко треба брати до уваги вагу самого важеля. Залежно від центру тяжіння – точки, де, як вважається, розташована уся його вага, механічна перевага може бути збільшена, незмінна чи зменшена.

Історично, важіль застосовували з доісторичних часів. Математичний принцип важеля (закон важеля) був відомий Аристотелю, але доведений грецьким математиком Архимедом (287-212 д.н. ч.). Згідно цього закону важіль знаходиться у рівновазі, коли продукт прикладеної сили і відстань від точки прикладення до осі обертання дорівнює результату опірної сили і відстані від точки її прикладення до осі обертання.

5. Discuss the history of arrangement and application of the simplest mechanisms through the interpreter. Use the expressions below.

1. What is the technical definition of a *machine*? Speaking of different machines, what does *force* mean? Speaking of machines, what does *efficiency* indicate? What does *work* mean? What is a *block and tackle*? Describe a *spring*. How does a *leaf spring* differ from the usual type of spring? What is a *prime mover*? What kinds of machines usually are *not* prime movers? What are *foot-pounds*? How much is one foot-pound?

What's the reason / use? The reason is, settle the question, I think it is absurd, Mind the details, The thing is that, How to evaluate it? Are you sure that, I doubt it, It is doubtful that, It requires careful investigation, there is another way, in this way, to identify a device, may be described as, depend on, it is easier, it is very helpful, we are not getting something for nothing.

ELEMENTS OF MACHINES

UNIT 6

Fastener a mechanical device for fastening things together.

Pin a short, thin, sharp-pointed length of metal with a small head at one end used for fastening or holding things together.

Nut small piece of metal for screwing on to the end of the bolt.

Bolt a metal pin with a thread at one end for a nut.

Thread cutting on the fastener.

Text 1

1. Find in the text the names of fasteners, their description and classification. Read and translate the text.

Kinds of Fasteners

The main standard threaded fasteners include bolts, studs, screws and nuts. The design forms and geometrical ratios of the heads of bolts,

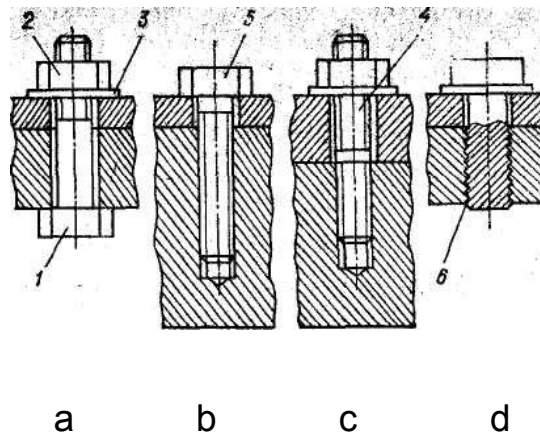


Fig. 12 a., b. bolts. c. stud. d. screw nut.

screws and nuts are versatile indeed. The choice of the design depends on the purpose of the joint. The heads may be hexagonal, square, countersunk, semi-circular, etc. They are also distinguished by the presence of the area that restricts the rotation of the bolt in tightening (for example, bolts with a larger semi-circular head and a nib, and bolts with a hexagonal diminished head and a guide underhead); by the method of clamping: externally, internally (with an internal hexagonal socket) on the end-face (heads with splines for a screw driver) and by other features. Depending on the purpose of the joint, and the conditions of assembly, nuts are selected differing in form (hexagonal, round, etc.), in thickness (normal, thin, thick). In various threaded joints, nuts can take external expanding load which is compressive or tensile. The latter nuts are known as tension nuts and they belong to the special design. Washers placed under heads or nuts, protect the finished portion of the jointed members against damage during tightening.

Vocabulary

threaded fastener нарізне кріплення

stud шпилька, штифт

screw гвинт

nut гайка

ratio відношення

versatile різноманітний

purpose призначення

countersunk зкритий

semicircular напівкруглий

distinguish відрізняти

restrict обмежувати

tighten

затягувати (гвинт)

helix

гвинтова лінія

2. Answer the following questions. Ask your own questions of different types on the text.

1. What do the main standard threaded fasteners include? 2. What are they used for? Are the design forms of the heads of bolts versatile? 3. What design forms of heads do you know? 4. What are the heads distinguished by? 5. When are studs used? 6. What are washers used for?

3. Find in the text the equivalents of the Ukrainian words and expressions.

нарізне кріплення, по висоті, форми конструкції, геометричні пропорції, призначення з'єднання, напівкруглі головки, розрізняються площиною, обмежують обертання, затягувати гвинт, умови зборки, товщина, зовнішнє різблення, внутрішнє різблення, наростаюче навантаження, захистити проти пошкодження, центр тяжіння, експериментальне дослідження, коефіцієнт тертя, застосовувати.

4. Fill in the gaps.

joint, clamp, features, expand, purpose, assembly, fasten, stud, design, thread, countersunk, rotate, tighten, tension, protect, damage.

The main standard threaded ____ include bolts, ____ screws and nuts. The ____ forms and geometrical ratios of the heads of bolts, screws and nuts are versatile indeed. The choice of the design depends on the purpose of the _____. The heads may be hexagonal, square, ____, semi-circular, etc. They are also distinguished by the presence of the area that restricts the ____ of the bolt in ____; by the method of ____:

externally, and by other _____. Depending on the _____ of the joint, and the conditions of _____, nuts are selected differing in form (hexagonal, round, etc.), in thickness (normal, thin, thick). In various _____ joints, nuts can take external _____ load which is compressive or tensile. The latter nuts are known as _____ nuts and they belong to the special _____. Washers _____ the jointed members against _____ during tightening.

5. Match the words.

1) depend, distinguish, tighten, choose, restrict, select, differ, take, protect, damage.

2) presence, purpose, form, rotation, load, bolt, nut, head, joint, design.

6. Describe the fasteners by the model.

Model. This is a washer. It is round in shape. It has a hole in the middle. It is made of steel. It is used (applied, employed) on screws and bolts.

7. Use the words with the same root in situations.

support – supporting – supported, transmit – transmitted – transmitting – transmission, apply – application – applicable, consider – considerable – unconsidered – considering, rotate – rotating – rotary – rotation, press – pressure – compress – compressor, – operate – operator – operation, produce – product – production – producer.

8. Group the synonyms and use them in situations.

turn, employ, fasten, cutting, transmit, alter, transfer, design, construct, build, use, utilize, convert, produce, revolve, transform, deliver,

join, create, apply, rotate, couple, thread, attach, purpose, unite, aim, change.

9. Develop the statements.

1. Fasteners are threaded. Threaded fasteners ____ 2. Fasteners are distinguished by ____ 3. Being placed under heads or nuts, ____ 4. Classification depending on the purpose ____ 5. External expanding load ____ 6. The jointed members ____ 7. The parts applied ____ 8. The machine parts produced ____ 9. Creating new machines ____ 10. The equilibrium conditions having been provided, the substance ____ 11. The decision having been taken, the meeting ____ 12. The student having obtained these results, the experiment ____ 13. The body ____, the force being removed ____.

10. Translate the text into English.

Основні види кріпильних деталей

Різьбові з'єднання належать до нерухомих зв'язків деталей машин. До них відносяться з'єднання за допомогою болтів, гвинтів, гвинтових стяжінь, тощо. Різьбове з'єднання рознімне за допомогою різьби. Різьбові з'єднання забезпечують відносну нерухомість з'єднаних деталей.

Головною перевагою болтового з'єднання є те, що при ньому не треба нарізати різьбу у деталях, що з'єднуються. Це особливо важливо у випадках неміцних і нетривких матеріалів виготовлення деталей. До недоліків болтового з'єднання можна віднести наступні: обидві з'єднані деталі повинні мати місця для розташування гайки чи головки гвинта, при закручуванні та відкручуванні гайки необхідно утримувати головку гвинта від прокручування, тощо.

Гвинти та шпильки застосовуються у тих випадках, коли постановка болта неможлива чи нераціональна. Наприклад, немає місця для розміщення гайки (головки); немає доступу до гайки (головки); при більшій товщині деталі необхідне глибоке свердлення і довгий болт, т. п.

Якщо при експлуатації деталь часто знімають і потім знову ставлять на місце, то її слід закріплювати болтами або шпильками, оскільки гвинти при багатократному закручуванні можуть пошкодити різьби в деталі. Пошкодження різьби більш вірогідно при маломіцних, крихких матеріалах, наприклад, з чавуну, дюралюмінію, тощо.

Підкладну шайбу ставлять під гайку чи головку гвинта для зменшення зм'яття деталі гайкою, якщо деталь виготовлена з менш міцного матеріалу (пластмаси, алюмінія, дерева і т. п.); запобігання чистих поверхней деталей від шкрябин при закручуванні гайки (гвинта); перекриття великого зазору отвору. В інших випадках підкладну шайбу ставити недоцільно. Крім підкладних шайб застосовують стопорні чи запобігаючі шайби, запобігають самовідкручуванню з'єднання.

12. Discuss the following problems using the words below.

1. Compare the advantages and disadvantages of different fastenings applied in joints. 2. Describe the application of fastenings in mechanisms.

1) depend on, distinguish, tighten, choose, restrict, select, differ, take, protect, damage, presence, purpose, form, rotation, load, bolt, nut, head, joint, design.

13. Word the mathematical symbols.

1) $y \rightarrow \infty$ y tends to infinity or y is tending to infinity. 2) $h(z) = 4$ the value of the function h in the point z is equal to four. 3) $\sin y = h$ the sine of y is equal to h . 4) $1/k$ one over k or one divided by k . 5) $b(\sqrt{2}) =$

2 b of the square root of two equals (is equal to) two, or the value of the square root of two equals (is equal to) two. 6) $z(\sqrt{2}) > z(1\frac{1}{2})$ the value, of the function z of the square root of two is greater than the value of this function of one and one half or z of the square root of two is greater than its value in the point one and one half.

Text 2

1. Read the text to describe the key notions.

Threads

Threads are applied for interconnection of machine parts and for transmitting motion from one part to another. When a thread is cut on the outside of a part it is known as an external or "male" thread. A thread is called an internal or "female" thread when it is cut inside of a part. Depending on the shape of the threading tool different profiles of thread are obtained, such as triangular, square or trapezoidal.



Fig. 13. a. triangular thread, b. trapezoidal thread.

In practice triangular threads are most widely used. The main elements of a thread are: the angle of the thread, the major, minor

and pitch diameters, depth and the pitch.

The angle of the thread is the angle included between the sides of the thread and measured in an axial plane. The major or outside diameter of a thread (sometimes referred to as "full diameter") is the distance between the two extreme outside points of the thread in the direction square to the axis. The major diameter is the largest diameter of the thread of a screw or a nut. The minor diameter, being the smallest diameter of the thread, is the distance between the two extreme inside points of the thread measured at the right angle to the axis. The minor diameter is also called the "core diameter" or "root diameter".

The pitch diameter is the distance between the two opposite parallel sides of the thread profile perpendicular to the thread axis. The depth of the thread is the distance between the crest and the base of the thread measured normal to the axis.

Classification of Threads. Classification into cylindrical and taper threads depends on the basic surface on which the thread is formed.

Threads can be cut into the surface or hole of a cylindrical bar or cone, and on the surface, the former being an internal thread and the latter — an external thread.

When the threading cylinder is turned clockwise to engage the second member, the thread is said to be right-hand and when counterclockwise—left-hand. The former of the contour that determines the thread profile in the plane passing through its axis gives us vee, trapezoidal, buttress, square and round threads. The number of starts classify threads as single and multiple (double, triple, etc.)

By the purpose, the threads are subdivided into fastening and lead. For fastening use is made of vee threads. They are distinguished by a higher strength of turns and can ensure a more stable

tightening than other types of threads due to a higher coefficient of friction. The principal parameters of a cylindrical thread are: major diameter, minor diameter, base thread depth, thread pitch, effective thread angle, helix angle.

Vocabulary

external, male	зовнішня
internal, female	внутрішня
pitch	висота
taper / vee thread	конічна / клиновидна різьба
counterclockwise	проти часової стрілки
engage	зачепляти
axis	вісь
buttress	підставка, підпорка
lead	вести
nib	вус
hanger	кронштейн, підвіска
elbow	коліно, патрубок

2. Find in the text.

1. The definition of the major diameter. 2. The definition of the pitch diameter. 3. The main elements of a thread. 4. The definition of the angle of a thread. 5. The types of screw threads.

3. Answer the questions on the text and ground the answers.

1. What are threads applied for? 2. When is a thread known as external or "male thread"? 3. When is a thread known as internal or

"female thread"? 4. How are different profiles of thread obtained? 5. What is the angle of a thread? 6. What is the major or outside diameter of a thread? 7. How is the angle of a thread measured? 8. What is the major diameter of a thread referred to? 9. What is the pitch diameter? 10. What is the depth of the thread? 1. What is the crest of the thread?

4. Translate the text into English.

Різьба

Різьба – гвинтова канавка на циліндричній або конічній поверхні гвинтів чи гайок, розташована по гвинтовій лінії. За формою основної поверхні розрізняють циліндричні та конічні різьблення. Найбільш розповсюджена циліндрична різьба. Конічна різьба застосовують для плотних з'єднань труб, масленок, пробок, ін. Профіль різьби – контур (наприклад, *abc*) січення різьби у площині, що проходить через основну поверхню. За формою профілю розрізняють трикутні, прямокутні, трапецеїдальні, круглі та інші різби. За місцем розміщення розрізняють внутрішню та зовнішню різьбу. За напрямком гвинтової лінії розрізняють праве та ліве різьблення. У правій різьбі гвинтова лінія йде зліва направо і вгору, у лівій – справа наліво і вгору. Найбільш розповсюджена ліва різьба.

За призначенням розрізняють різби кріпильні, і різби для гвинтових з'єднань. Кріпильні різби включають метричну з трикутним профілем – основне кріпільне різьблення, трубну – трикутне із закругленими вершинами і западинами і різьбу гвинтів для дерева.

Різьби гвинтових механізмів (ходові різби) прямокутна, трапецеїдальна симетрична, трапецеїдальна несиметрична чи упорна.

Метрична різьба отримала таку назву тому, що всі її розміри вимірюються у міліметрах на відміну від дюймової різьби, розміри якої вимірюються у дюймах.

Стандарт передбачає метричну різьбу з великим та дрібним шагом. Для одного й того ж діаметра d дрібна різьба відрізняється від великої значенням шагу p . При зменшенні шага відповідно зменшується висота різьби і кут підйому різьби, а внутрішній діаметр збільшується.

5. Discuss the following topics using participles as well as introductory and connective words.

1. Kinds of fastenings. 2. Their application. 3. Kinds of threads.

POWER-TRANSMISSION EQUIPMENT

UNIT 7

1. Learn the notions and their definitions.

Mechanism A component of a machine that transmits or changes motion.

Coupling A machine element used to join one shaft to another, permanent or semipermanent connections.

Clutch A mechanism permitting easy and quick connection and disconnection of two shafts.

Key a machine part composed of one detail insert into another, used to transmit torque between a shaft and a machine part assembled on it.

Cam A rotating or sliding piece of machinery that acts as part of pair to impart or receive motion.

Follower The other part of a cam mechanism, usually a rod and shaft that receives and transmits motion from the cam.

Ratchet A mechanism that works with a *pawl*. The ratchet is a bar or wheel with inclined teeth; the pawl is usually a rod that can drop between the teeth to permit motion in only one direction.

Text 1

1. Read and translate the following text. Define the words – connectors between the title, text, paragraphs and sentences.

Couplings

Couplings are machine elements used to join one shaft to another, which are needed because of specialized operations of the machine – for example, installation or servicing. The coupling of an electric motor driving a water pump or a gear box may transmit power while preventing an overload, compensate for misalignments of machinery, and minimize vibrations. Couplings normally form permanent or semipermanent connections between shafts, while clutches are associated with rapid engagement.

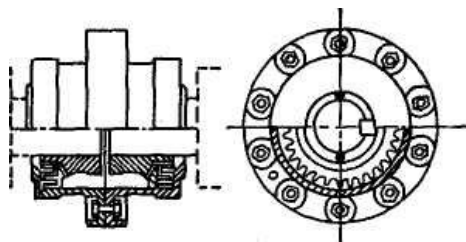


Fig. 14. Gear and dental flexible coupling.

Solid couplings consist of rigid flanges on each shaft, bolted solidly together to form a continuous stiff shaft. Their use is favored when it is desired that the connected machines act as a single unit (for example, the rotor of a motor or generator may be used as the flywheel of a reciprocating engine or compressor) or to reduce over-all length (such as an overhanging blower) or to

eliminate bearings (by coupling components together such as a gear pinion to a turbine). Shaft misalignment can result between the two shafts, increases bearing loads, and produces a frictional power loss. It is this frictional power that imposes a limitation on the allowable misalignment of high-speed

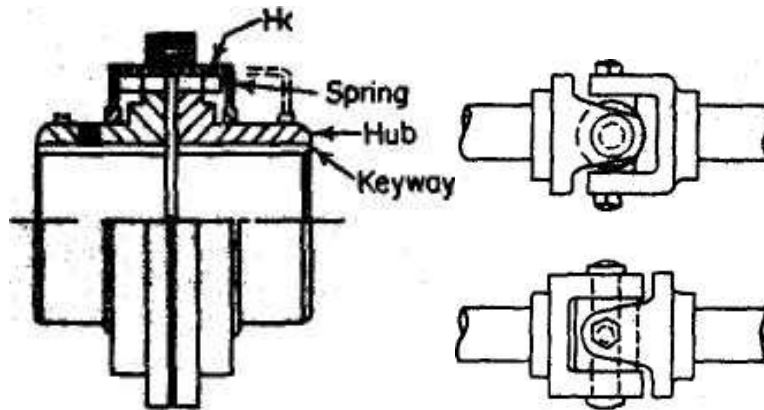


Fig. 15. Solid couplings.

shafts, because the friction heat increases faster with speed than the heat-dissipation ability.

Couplings for high-speed and / or high-power machinery are almost exclusively of the gear (or dental) type. Torque is transmitted by two coupling halves bolted together, which have at each end an internal gear that meshes with gear teeth machined on the periphery of the shaft flanges. Under running conditions, misalignment, errors in tooth spacing, etc., will cause movement between the mating gear teeth, requiring that lubricating oil or grease be used to prevent damage by fretting.

Disconnectable Couplings. When it is necessary to disconnect or connect machines while in operation a jaw-type coupling can be used provided it is operated only when the two shafts are running at the same speed. Friction clutches allow the shafts to be engaged while revolving at different speeds, and overrunning clutches will disengage automatically when

the speed of the driven unit exceeds that of the driver. Overrunning clutches may be of a jaw type or may use oval pins between an inner and an outer raceway which jam when the torque is in one direction and roll out of engagement for reversed torques. These devices can be used to prevent reverse rotation.

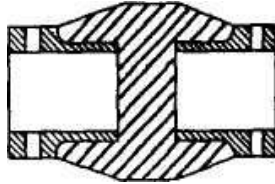


Fig. 16. Rubber flexible coupling..

Flexible couplings can be designed to compensate for shaft misalignment or to modify the torsional flexibility of shafts to reduce the effect of torque variations. Torsional flexibility is obtained by using rubber bushings between the bolts and the flanges or, for jaw-type clutches, by use of rubber inserts or rubber bushings between the flange and the shaft. Still other designs use straps to transmit the torque. Couplings that are designed for misalignment use straps, knuckle joints, wobble plates, or some other mechanism that allows a sliding action between meshing parts.

Hydraulic coupling. The hydraulic coupling consists of two open-faced vaned impellers placed face to face and enclosed in a housing containing oil. The rotation of an impeller connected to the driver creates a vortex. The output impeller, connected to the driven machine, obtains its power by slowing down the vortex. The shafts are coupled by filling the case with oil and are disconnected by draining.

An electric coupling consists of a metal ring connected to the driver shaft, which surrounds an electromagnet mounted on the output shaft. Shafts are coupled by energizing the magnet and disconnected by demagnetizing the field.

Variable speed is obtained by regulating the current to the electromagnet and slip losses are dissipated with air or water circulation.

Note. open-faced vaned impeller – відкрита гідропередача.

Vocabulary

coupling	жорстка муфта
installation	установка
gear box	коробка передач
transmit power	передавати енергію
misalignment	розцентровка
engagement	зачеплення
reciprocationg	зворотньо-поступальний
overhanging blower	навісний насос
gear pinion	шпонка
mesh with	зчеплюватися з
mating gear teeth	парні зуби шестерні
prevent damage	запобігати пошкодженню
rotate,	обертатися
flywheel	махове колесо
rigid flanges	жорсткці фланці
rubber bushings	гумові втулки
torsional flexibility	гнучкість
jaw-type coupling	муфта
housing, casing	кожух
vortex	вихрь
heat dissipation	розсіювання тепла

2. Answer the following questions.

1. What is a coupling used for? 2. Is a coupling used to connect shafts

permanently? 3. What is the relation between the kind of a coupling and its application? 4. What does a clutch permit? 5. What factors are taken into consideration in deciding what clutch to use? 6. What is the object of a friction clutch? 7. How are clutches subdivided and arranged? 8. How does a *mechanism* differ from a machine?

3. Find in the text the equivalents of the Ukrainian words and expressions.

деталі машин, керувати насосом, випереджувати перевантаження, жорстка муфта, жорстко скріплені болтами, швидке зчеплення, діяти як єдиний блок, зменшувати вібрацію, напівпостійне з'єднання, вилучати підшипники, може трапитися, розцентровка валу, нести навантаження, накладати обмеження, спричиняти рух, парні зуби шестерні, змащувальне масло, запобігати пошкодженню тертям, зворотній обертальний момент, надмірна напруга, з'єднати болтами, машина працює, керувати рухом.

4. Fill in the gaps.

form, drive, elements, consist, bolted, desired, reciprocating, eliminate, coupling, operation, misalignment, installation, engagement, increases.

Couplings are machine ____ used to join one shaft to another, which are needed because of specialized ____ of the machine – for example, ____ or servicing. The coupling of an electric motor ____ a water pump or a gear box may transmit power. Couplings normally ____ permanent or semipermanent connections between shafts, while clutches are associated with rapid _____. Solid couplings ____ of rigid flanges on each shaft, ____ solidly together to form a continuous stiff shaft. Their use is favored when it is ____ that the connected machines act as a single unit (for example, the rotor of a motor or generator may be used as the flywheel of a ____ engine or compressor) or to

reduce over-all length (such as an overhanging blower) or to ____ bearings (by ____ components together such as a gear pinion to a turbine). Shaft ____ can result between the two shafts, ____ bearing loads. Jaw-type coupling is operated only when the two shafts are ____ at the same speed.

5. Use the words with the same root in situations.

case – casing, join – joint, design – designing – designed – designer, prevent – preventive – prevention.

6. Group the synonyms and use them in situations.

run, act, result, made of, apply, link, casing, fast, use, stiff, fasten, carry, consist of, join, quick, solid, couple, rigid, composed of, operate, attach, cause, bear, make, follow, rapid, housing, utilize, cover, connect.

7. Complete the words with the negative prefixes: semi-, dis-, un-, de-, in-, mis-, over.

1. There are permanent and ____-permanent joints. What has the form of a ____-circle? 2. Overloaded machine component may be ____-formed. 3. ____-connectable joints are widely used. 4. ____-use of a machine part will result in its breaking. 5. There is nothing ____-usual in mechanics. 6. Machine components will be ____-shaped if they do not resist stresses. 7. What ____-directional quantities do you know? 8. ____-alignment may occur. 9. ____-running clutches may be of a jaw type.

8. Transform the subordinate clauses into the Absolute Nominal Participle Construction.

Model 1. The assembling finished, the conveyer was put into operation.

Model 2. We discussed our problems, the computer working.

1. As the problem had been solved, the engineers began a new

experiment. 2. When the plan had been discussed, the meeting was over. 3. Since this law had been discovered, there are a lot of new possibilities. 4. After the engineer had come, the experiment began. 5. Because the strain of the body exceeds a certain value, the body does not recover completely. 6. A body is under hydrostatic stress, so the pressure upon it on all sides is the same. 7. When a body is under tensile stress, the forces acting upon it tend to increase its length. 8. An external force is acting, and the body changes its state of rest to a state of motion. 9. The elastic properties of various materials are different, but the ratio of stress to strain is always the same for a given material within the elastic limit. 10. When the distorting force is removed, elastic bodies exhibit the property of recovering to their original state.

9. Discuss the advantages and disadvantages of different types of couplings.

Text 2

1. Scan the text to receive information.

Clutches

A clutch permits easy and quick connection and disconnection of two shafts. Factors which must be taken into consideration in deciding what type of clutch is to be used are: torque, rotation, speed, available space and frequency of operation. The object of friction clutches is to connect a stationary machine part to a rotating part, to bring it up to speed and to transmit the required power with a minimum of slippage. A clutch is also used instead of a key to connect the shaft with a revolving part, such as a pulley or a gear. Friction clutches may be divided into two main groups

according to the direction of the acting force: axial clutches and radial clutches.

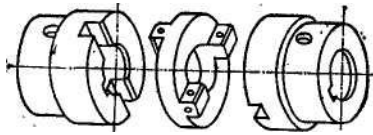


Fig. 17. a clutch.

Classification of Clutches. Friction clutches may be divided into two main groups according to the direction of the acting force: axial clutches and radial ones.

Axial clutches are those which have the contact pressure applied in the direction parallel to the axis of rotation. Axial clutches, in turn, can be subdivided into: a) cone clutches, b) disc clutches and c) combined cone and disc clutches. In radial clutches the contact pressure is applied upon a rim in a radial direction. These clutches may be subdivided into band clutches and block clutches, also into external, internal and combined internal and external clutches.

Vocabulary

transmit torque	передавати обертальний момент
rotate, revolve	обертатися
frequency	частота
friction clutch	фрикційна муфта
slippage	ковзання

2. Ask questions on the text.

3. Explain the use of different types of clutches.

4. Translate the following text into English.

Муфта

Муфта (від нім. Muffe) в техніці — пристрій, що постійно або тимчасово з'єднує між собою *вали, труби, сталеві кабелі* чи ін. циліндричні деталі (вироби); передає обертовий рух і обертальні моменти з одного вала на інший або з вала на вільно розміщену на ньому деталь (напр., зубчасте колесо). До того ж, така муфта компенсує невеликі монтажні відхилення, роз'єднує вали, запобігає виходу з ладу машини в аварійному режимі тощо. Розрізняють муфта жорсткі некомпенсуючі, або глухі— з жорстким з'єднанням деталей; жорсткі компенсуючі (напр., деякі зубчасті) — з невеликим взаємним зміщенням з'єднуваних деталей; жорсткі рухомі (напр., кулачково-дискові) — зі значним взаємним зміщенням з'єднуваних деталей; пружні, що зменшують коливання і динамічні навантаження (деякі — з незначним зміщенням з'єднуваних деталей). Є муфти керовані, або зчіпні (напр., фрикційні — з використанням тертя) — зі з'єднанням і роз'єднанням деталей під час дії машини; самокеровані, або автоматичні, кінцеві, стопорні та ін.

5. Make up the dialogues on the following topics using the participles as well as the introductory and connective words.

1. The difference between coupling and clutches. 2. Kinds of couplings. 3. Kinds of clutches. 4. The principle of their operation. 5. The conditions of operation. 6. Application and advantages / disadvantages in operation, maintenance and wear.

in this case, in case of, provided, on one hand, on the other hand, especially, it is required that, it is desired that, on condition, in general, in particular, in detail, in connection with, according to, to add, to continue.

Text 3

1. Scan the text for the types of keys and their purpose. Compare their function with those of other transmitting mechanisms.

Types of Keys

The main function of a key is to transmit torque between a shaft and a machine part assembled on it.

In most cases keys prevent relative motion, both rotary and axial. In some constructions keys allow an axial motion, between the shaft and the hub. Such keys are called feather spline keys. According to various characteristics, keys can be distinguished as straight and tapered, rectangular, dovetailed, chamfered, round, and discshaped, radial and tangential, and according to their use, for light duty and for heavy duty.

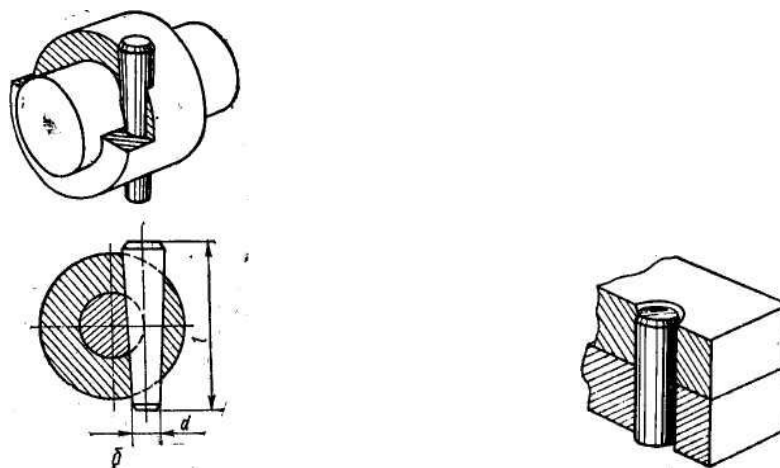


Fig. 18. Keys.

Vocabulary

assemble	збирати
hub	втулка
slip, slide	ковзання
journal	цапфа

rub	терти
rock	коливатися
supply	постачання, подача
shaft	вал
driver, impeller	привід
feather / spline key	напрямна шпонка
tapered	нарізний
light duty	невеликий строк експлуатації

2. Use the given introductory words to agree or disagree with the statements below. Give your comments.

1. A key doesn't transmit torque between a shaft and machine part. 2. In most cases keys prevent relative motion, both rotary and axial. 3. In constructions where keys do not allow an axial motion between the shaft and the hub are called feather or spline keys. 4. There are only two types of keys: straight and tapered. 5. According to various characteristics the keys can be used only for light duty. 6. One can give a simple, all-embracing classification of keys.

3. Answer the questions on the text.

1. What is the main function of a key? 2. How many key types are in use? 3. Where are the keys used?

4. Find in the text the equivalents of the Ukrainian words and expressions:

згідно з, розрізнятися рисами, в більшості, дозволяти аксіальний рух, між валом та втулкою, передавати обертальний момент, зібрана деталь, випереджувати відносний рух, напрямна шпонка, нарізна шпонка, пристрій для роз'ємного з'єднання, засновуватися на, поділятися на, велике навантаження, риси переплітаються, всеохоплююча класифікація,

з'єднувати постійно, для полегдження, муфта дозволяє, зовнішня муфта, застосовується в напрямку, паралельно осі обертання, брати до уваги, належна робота.

5. Fill in the gaps.

use, torque, allow, distinguished, assembled, prevent.

The main function of a key is to transmit _____ between a shaft and a machine part _____ on it. In most cases keys _____ relative motion, both rotary and axial. In some constructions keys _____ an axial motion, between the shaft and the hub. According to various characteristics, keys can be _____ as straight and tapered, rectangular, etc., and according to their _____, for light duty and for heavy duty

6. Discuss the machine details using participles as well as the connective and introductory words.

1. The distinctive features of a key. 2. Kinds of a key. 3. Keys application.

Text 4

1. Find in the text the information about the mechanisms mentioned.

Study the text deeper for the details, classifications, and arrangement.

Cams and Other Mechanisms

The cam is an especially important element of a machine — simple and practical, allowing an infinite variety of output motions. In the simplest cam system there are a fixed link, the frame; a driving link, which is generally the cam; and an output link called the *follower*. (See Figure). The cam-follower system is the distinctive feature of valve trains in gasoline and Diesel engines, all types of printing machinery, textile machinery, pumps, and machine tools.

Three kinds of cams are the disk, cylindrical, and three-dimensional. An alternate classification based on the type of output motion include constant-velocity, uniform-acceleration-deceleration, simple harmonic, cycloidal, or polynomial cams.

Geneva wheel (Fig. 20) consists of a driver wheel and a driven wheel. The driver rotates at a constant speed. It contains a pin, which enters a slot on the driven wheel and thus turns it. After the pin leaves the slot, the driven wheel stays still until the pin enters the next slot. Thus the constantly rotating driver produces intermittent rotation in the driven wheel.

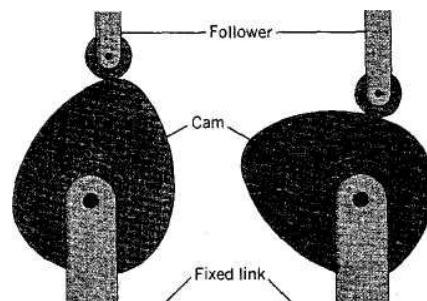


Fig. 19. Geneva wheel with two cams, follower (top) and fixed link (bottom).

Geneva wheel is often used on machine tools for indexing the rotation of a shaft — that is, to rotate the shaft a certain amount and then stop for a certain length of time before the next rotation.

Ratchets are vital parts of mechanical devices ranging from automobile parking brake, jacks to typewriters.

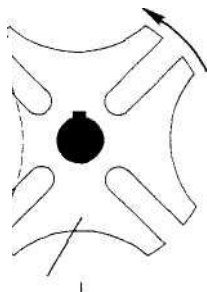


Fig. 20. Driven wheel.

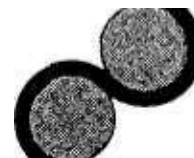


Fig. 21. Rolamite.

A *rolamite* (Fig. 21) consists of two cylindrical rollers suspended in an S-shaped, flexible band. In the arrangement shown (a), if the rollers roll in the direction of the arrows, they will both move to the right (b). The ends of the band are fastened to the two guide rails. Rolamites are used principally in mechanical and electromechanical components.

Vocabulary

cam	кулачок
output link	вихідне з'єднання (тяга)
valve trains	зубчаста передача клапану
machine tool	механічний верстат
reciprocate	рухатися зворотньо-поступально
slot	прорізь, паз
ratchet	храповик
index	вказівник
intermittent rotation	скачкоподібний обертальний рух
range	дистанція
jack	підйомник, домкрат, гвинтова стойка
uniform	однорідний
Geneva wheel	мальтійський хрест
prevent overwinding	запобігати перекручуванню

2. Answer the questions on the text.

1. What is a cam? 2. Why is a cam an especially important element of a machine? 3. Where are cams used? 4. How are cams classified? 5. How is Geneva wheel arranged and where is it applied? 6. What is a ratchet / rolamite?

3. Translate the text into English.

Кулачкові механізми. Основні поняття і визначення

Кулачкові механізми широко розповсюджені в техніці, особливо для автоматизації різних процесів, що потребують здійснення певного закону руху веденої ланки.

На рис. 22 наведено основні типи плоских кулачкових механізмів, що відрізняються як за характером руху ведучих і ведених ланок, так і за характером обрису елементів ланок вищої кінематичної пари.

Найпростішим кулачковим механізмом є триланковий кінематичний ланцюг з однією вищою парою, який складається з кулачка 1, штовхача 2 і стояка 3.

Кулачком називається ланка вищої кінематичної пари, елемент якої має змінну кривизну. Інша ланка цієї пари має простішу форму і називається *штовхонем* (рис. 5.1, а, б, в, є), якщо вона виконує поступальний рух, і *коромислом* (рис. 5.1, г, д), якщо вона виконує коливальний рух. *Профілем кулачка* називається крива, отримана в перетині кулачка площиною, яка паралельна площині руху кулачка. Профіль кулачка визначає закон руху веденої ланки. Під час роботи кулачкового механізму потрібно, щоб ланки, які входять у вищу кінематичну пару, знаходились у постійному дотику, тобто кінематична пара повинна бути замкненою.

За величинами сил і реакцій у кінематичних парах виконуються розрахунки на міцність ланок або елементів їх кінематичних пар. Для того, щоб механізм перебував у стані рівноваги під дією зовнішніх сил, до однієї його ланки необхідно прикласти зрівноважувальну силу P_z або зрівноважувальну пару сил, яка характеризується її моментом M – зрівноважувальним моментом. Цю силу P або момент M_{zp} зазвичай прикладають до ведучої ланки, яка отримує ззовні енергію, необхідну

для руху ланок механізму робочої машини, або віддає її, як це має місце у механізмів - двигунів.

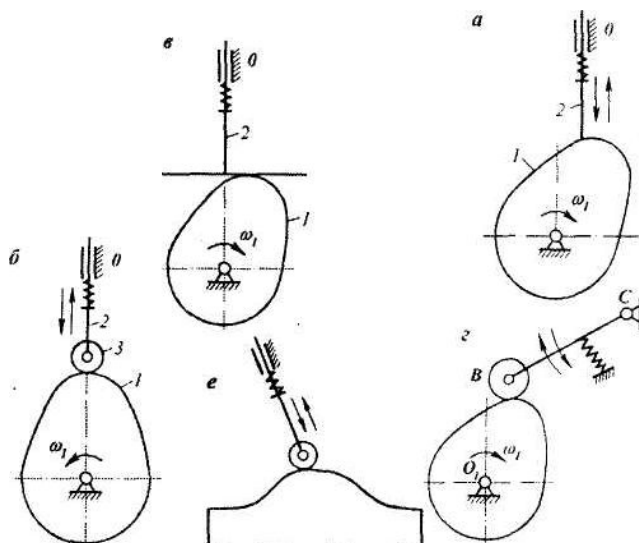


Fig. 22. Схеми кулачкових механізмів з силовим замиканням.

4. A. Discuss the machine details using special terms as well as the connective and introductory words.

1. Definition of a cam and its characteristics. 2.Cams classification. 3.Calculations of the cams kinematic pairs for strength.

1) to act, load, angle, motion, axis, moving, bearing, to rotate, to carry, to support, to confine, journal, wear, wheel.

2) proceeding from, according to, considering, taking into consideration, taking into account, dealing with, provided, connected with, in connection with, in accordance with, in relation with, regarding, as for, as to, concerning.

B.Discuss the mechanical devices that take advantage of friction. Include some that are not mentioned in the texts.

5. Read and translate the text. Add what you know on the topic

using the introductory words.

Functions

Leibniz (1646-1716), who first used the word "function", the notion of function was identified with the simple formula expressing the exact nature of relationship. All modern mathematics centres around the concept of function. The concept of function is of the greatest importance not only in pure mathematics but also in practical applications. Physical laws are statements concerning the way in which certain quantities depend on others when some of these vary. The task of the physicist is determining the exact or approximate nature of this functional dependence. An expression such as $x^2 + 2x - 3$ has no definite numerical value until the value of x is assigned.

We say that the value of this expression is a function of the value of x , and write $x^2 + 2x - 3 = f(x)$

For example, when $x = 2$ then

$$2^2 + 2 \cdot 2 - 3 = 5, \text{ so that } f(2) = 5.$$

In the same way we may find by direct substitution the value of $f(x)$ for any integral, fractional, irrational, or even complex number x .

The area of a triangle is a function of the lengths of its three sides; The atmospheric pressure is a function of the altitude above sea level. The whole domain of periodic phenomena — the motion of the tides, the vibrations of a plucked string, the emission of light waves — is governed by the simple trigonometric functions $\sin x$ and $\cos x$.

6. Make a summary of the text, use 'since' or 'because' wherever possible.

UNIT 8

1. Learn the notions and their definitions.

Washer A flat disc, ring of metal, rubber etc., locking a nut in a place.

Shaft A machine part supporting and confining a moving part.

Gear A toothed wheel designed for being engaged with another one or with a worm.

Spur Gear A gear with straight teeth parallel to the axis.

Pinion The smaller member of a pair of gears or the smallest gear of a series; gear is used to designate the larger member.

Helical Gear A gear with teeth cut in the shape of a helix

Herringbone Gear A helical gear with two sets of teeth at equal but opposite angles to each other.

Bevel Gear A gear with teeth slanted at an angle to the plane of the wheel itself.

Worm Gear A mechanism consisting of a gear that meshes with a *worm*, a screw with helical teeth.

Sun-and-Planet Gears An arrangement in which a smaller gear (the planet) rotates around a larger gear (the sun).

Casing, housing A machine covering

Bearing That part of a machine which supports parts in relative Motion.

Text 1

2. Read the text and give titles to paragraphs. Translate the text.

Types of Gears

This is a gear. It is a set of toothed wheels working together in a

machine. The gears may be different types: adjusting gear, bevel gear, cone friction gear, clutch gear, feed gear.

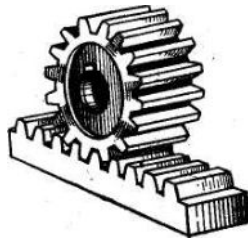


Fig. 23. Rack and pinion

Gears are used in machines to transmit motion and power by means of positive, contact between toothed wheels. Gears are a form of wheel-and-axle. Gears may be classified according to their shaft (axle) relationship. Three such types are parallel, intersecting, and skewed shafts. Spur and helical gears are commonly used with parallel shafts, bevel gears with intersecting shafts, and helical and worm gears with skewed shafts. One of the most common examples of gearing in a machine is the transmission of an automobile. Gears are a vital part of such household machines as the hand-held drill, the electric saw, the hedge-clipper, and the snowblower. Gears are also classified according to the shape of their teeth. The major types are spur, helical, bevel, hypoid, and worm and wheel gears

Spur Gears. The form of spur gear teeth resembles a mathematical curve – usually the involute, sometimes the cycloid. Only a portion of the tooth follows the involute form because the lower part of the tooth (flank) must provide adequate clearance. In ordinary spur gears, the teeth are cut parallel to the working shaft. This means that there is no side thrust on the shaft. It also means that only a limited number of teeth can be in meshing contact at a given time. One special configuration of spur gears is called a *planetary gear train* (see illustration). It has been used in automobiles and propeller-driven aircraft.

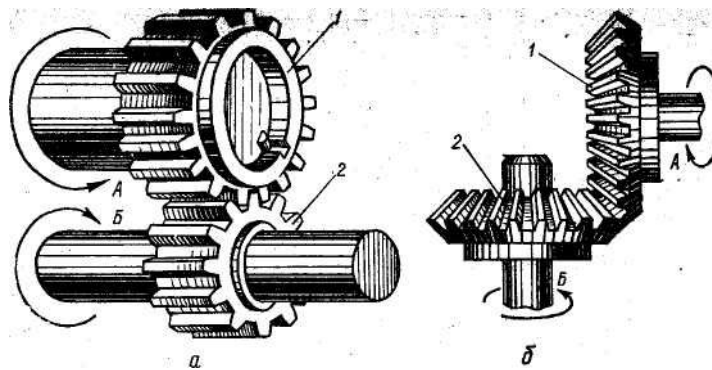


Fig. 24. a. spur gears engaging b. spiral bevel gears engaging

Helical Gears. Helical gears are usually used for large power transmission. Such gears are cut in the form of helices and thus lie at an angle to the shaft. Because gearing cut at an angle causes a side thrust on the shaft, it is customary to cut such gears double, so that each series of teeth offsets the side thrust of the other.

Bevel Gears. The driving pinion and ring gear are spiral bevel gears—that is, each gear tooth follows the curve of a spiral. The idler and side gears have straight teeth. Bevel gears are frequently used to drive vertical pumps or process machinery with horizontal drivers.

Worm and Wheel Gears is another type of gearing used for nonintersecting shafts or extensions of shafts and make use of worm and wheel gear. The driving gear is a rotating, spiral (worm) that meshes with the teeth of the wheel. Large speed reductions are possible with this arrangement. Gear teeth of a cycloidal profile engage in a rolling action which minimizes friction; however, pinion and gear shafts of cycloidal gears must be very accurately aligned and spaced.

Planetary gears consist of three sets of gears, a pinion (sun gear) meshing with two or more planet gears which in turn rotate within a stationary internal gear, that is forming part of the housing. The planet gears are connected to one shaft and the sun gear to the other shaft. Planetary-gear

systems are compact, achieve a large reduction in a limited space, and result in input and output shafts in the same center line.

Vocabulary

set of toothed wheels	набір зубчастих механізмів
bevel gear	конічне зубчасте колесо
spur gear	циліндричне прямозубне колесо
pinion (sun gear)	шестерня (менша в парі)
rack	зубчаста рейка
skewed shaft	гвинтовий вал
clearance	зазор
side thrust	боковий поштовх, удар
reduction	пониження, послаблення
offset	зсув, зміщення
overhang	нависати
wear	зношуватися
arrangement	розташування
impact	вплив
precision	точність
aligned and spaced	зцентровані та розміщені на відстані
pinion	нарізна планка
involute	складний, закручений спіраллю

3. Ask questions on the text

1.What is linear motion? What is it called technically? 2. What is reciprocating motion? 3. What is rotary motion? 4. What does torque mean? 5. What is axial motion? 6.Can you describe a gear? 7. How are the teeth cut in a spur .gear? 8. What is a pinion? 9. How are the teeth cut in a helical gear? 10. How are the teeth cut in a bevel gear? 11. What is a worm gear? 12. Describe a rack and pinion mechanism. 13. What is a driving wheel? 14. What is a follower

(mate)? 15. What is a linkage?

4. Find in the text the equivalents of the Ukrainian words and expressions.

циліндричне / конічне зубчасте колесо, фрикційна шестерня, у зчепленні з, декількома способами, побутові прилади, ручне свердло, спеціальний пристрій, видалення тепла, поверхні зношення, нагадує криву, забезпечувати достатній зазор, обертаючийся черв'як, низька ефективність, розсіювання енергії, включене у рух котіння, зменшення / збільшення швидкості, акуратно зцентрований, досягати скользяння, видалення тепла, погрішності виробництва, висока точність, працювати з великою швидкістю, надають перевагу, працюючий вал.

5. Fill in the gaps.

intersect, operate, use, resembles, provide, thrust, mesh, transmit, precision, drive, engage, causes, reductions, wear, removal, loading.

Gears are ____ in machines to transmit motion and power by means of positive, contact between toothed wheels. Three such types are parallel, ____, and skewed shafts. Only a portion of the tooth ____ the involute form because the lower part of the tooth (flank) must ____ adequate clearance. This means that there is no side ____ on the shaft. It also means that only a limited number of teeth can be in ____ contact at a given time. One special configuration of spur gears is called a planetary gear ____ . It has been used in automobiles and propeller-____ aircraft. Because gearing cut at an angle ____ a side thrust on the shaft, it is customary to cut such gears double. Large speed ____ are possible with this arrangement. When heavy power is transmitted, the ____ on the gears is high. Poor efficiency and heat ____ of dissipated energy limits worm gears to low-speed applications. Gear teeth of a cycloidal profile ____ in a rolling

action. Impact ____ increased with increasing pitch-line velocity and with manufacturing inaccuracies. As a result high-speed gears are always of the ____ type (Class 3). Gears are more compact and can ____ at much higher speeds and power than other speed-reduction mechanisms.

6. Match the types of gears and find their descriptions in the text.

1) adjusting gear, bevel gear, clutch gear, worm gear, spur gear, wheel-and-axle, feed gear.

2) циліндричне прямозубе колесо, ведуча шестерня, черв'ячна передача, ворот, конічне зубчасте колесо, регулююча шестерня, муфтна передача.

7. Group the synonyms.

engage with, part, impact, cross, use, rotate, lock, cover, oil, thread, speed, mesh with, decrease, roll, unite, insert, deliver, put in, transfer, enclose, power, element, close, remove, measure, keep smth, join, grease, component, reduce, connect, combine, energy, slide, drive, turn, direct, velocity, hold smth, extract, put out, energy, revolve, intersect, include, transmit, cutting, detail, fasten, application, limit, influence, lessen, lubrication.

8. Fill in the gaps.

a) 1. ____ the body with screws. 2. Two plates may be ____ by soldering. 3. The wheels of the car are not well _____. 4. The key is a rather reliable type of _____. 5. The electric motor is _____ to the food machines by wires. 6. _____ joint reminds key joint.

a. fix, b. attach, c. fasten, d. join, e. couple, f. connect

b) 1. This detail is _____ on the shaft. 2. The new equipment was _____ in the foundry shop. 3. The motion is _____ through the toothed wheels.

4. You may _____ your own venture. 5. Energy _____ takes place in different ways. 4. Computers are _____ to control the production process.

a. install, b. mount, c. establish, d. adjust, e. transfer, f. transmit

9. Use the words with the same root in situations.

adjust – adjusting – adjusted – adjustment, feed – feeder – feeding – fed, drive – driven – driver – driving, section – intersect – intersection – intersecting – intersected – cross-section, install – installation, connect – connectable – disconnectable, rotate – rotator – rotation – rotating, revolve – revolving – revolver, divide – division, combine – combination, product – produce – production – productivity – producer, transmit – transmission.

6. Define the machine parts.

screw, washer, shaft, gear, key, pin, bearing, gear, rivet, nut, casing.

9. Finish the sentences to describe the power transmitting devices.

A. 1. To prove the idea / fact _____. 2. To illustrate the phenomena _____.
3. To begin with _____. 4. To defend the idea _____. 5. To exemplify the statement _____. 6. To tell the truth _____. 7. To continue _____. 8. To finish / conclude _____.
9. To make a long story short _____. 10. To support the statement _____. 11. To supply the examples _____. 12. To add _____. 14. To take into consideration _____. 15. To ground the theory _____.

B. 1. I find (believe) it necessary to _____. 2. It is for us to _____. 3. Allow me to _____. 4. We want them to _____. 5. It is important to _____. 7. Someone advised him to _____. 8. I asked you to _____.

C. 1. There are problems to _____. 2. It is a fact to _____. 3. I have the report to _____.

10. Translate the text into English.

Зубчаста передача — механічна *передача*, в якій енергія від ведучої

ланки до веденої передається за допомогою зубчастих коліс. За взаємним розміщенням осей обертання коліс розрізняють зубчасті передачі циліндричні, конічні, гвинтові; за кількістю послідовно зачеплених пар коліс — одно- і багато ступінчасті; за формою профілю зубців — евольвентні і неевольвентні; за розміщенням зубців у колесах — зовнішні і внутрішні; з прямими, косими і криволінійними зубцями. Зубчасті передачі відзначаються високим кпд (0,97— 0,99 у одноступінчастих), значною довговічністю і надійністю в експлуатації, компактністю. Застосовують їх як окремі агрегати — *редуктори* або як складові частини машин і механізмів.

Зубчасте з'єднання, шліцьове з'єднання — з'єднання *деталей машин* за допомогою виступів (зубців), що входять у відповідні западини (шліці) сполучуваної деталі. За профілем зубців розрізняють зубчасте з'єднання прямобічне (найпоширеніше), а також евольвентне і дрібнозубе трикутне. За умовами експлуатації зубчасті з'єднання поділяють на рухомі (ковзні), коли деталь, насаджена на вал, може переміщуватися в осьовому напрямі, і нерухомі.

11. Speak on the following topics.

1. Classification of the gears. 2. Shape (form) of the gears, their composition, material. 3. Gears applications in various machines.

12. Consider the definitions and examples of mathematical notions and tell what you know on the topic.

Variable and Function

Function deals with the set of values of a variable y when another

variable x takes certain values.

Consider, for example, the two functions:

- (i) the function whose value is 1 when $x \geq 0$ and 0 when $x < 0$;
- (ii) the function whose value is 1 when x is rational and 0 when x is irrational.

The set of values of each of these functions is the finite set containing the two numbers 0 and 1; but the two functions are quite different from each other. The sets of values of the two functions x^3 and x^5 are identical (in this case the set of all real numbers), but the functions are not the same.

The essential feature of the definition of a function is the concept of a "correspondence" or "relationship" between individual members of two sets. This correspondence known as many-one, that is if x denotes any member one set and y any member of the other, then to one value of y there may correspond one, or several, or even infinitely many values of x .

Definition: If to each member x of a certain set M there corresponds one value of a variable y then y is said to be a function of the variable x . The variable x is called the argument of the function, and the set M the domain of the function. The set of all the values taken by the variable y is called the ordinate set. Both the domain and the ordinate set may be either finite or infinite, bounded or unbounded. A function is frequently denoted by a symbol such as $f(x)$.

Text 2

1. Read the following text and describe the drawings.

Bearing. Types of Bearings

Bearing is a machine part which supports a moving part and

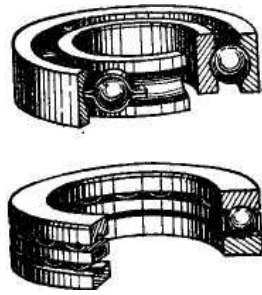


Fig. 25

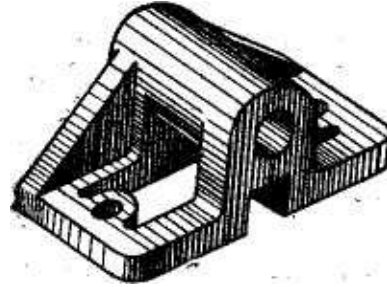


Fig. 26

confines its motion. That part of a shaft which rotates in a bearing is called a journal. Bearings of parts having a rocking motion belong to the second class, bearings with a continuous rotary motion form the great majority of all bearings.

Bearings in which one rubbing surface slides over another are called plain bearings. They may be divided into two classes: 1) those with a continuous rotary motion and 2) those with an intermittent motion. Journal bearings belong to the first class. Bearings with a continuous rotary motion are the only ones in which an oil film pressure is adequate to support the journal itself.

Here are some types of bearings: a) a sliding bearing, b) an antifriction bearings, c) a radial ball bearing d) an axial ball bearing.

Ball bearing consists of two rings: an inner ring and an outer ring between which there are hardened steel balls spaced in ball retainer or cage. In rotating machines the balls are spaced so that they do not touch each other, thus reducing wear and noise. They require an absolutely parallel raceway to roll upon, entirely free from eccentricity of vibration.

Notes. ft./min – foot per minute

lb – pound = 453,59 grams.

Vocabulary

bearing	підшипник
journal	цапфа, шпонка
intermittent	перервний, ритмічний
sliding	ковзаючий
ball retainer	сепаратор підшипника

2. Answer the questions on the text.

1. What is called a bearing? 2. What does a bearing support (confine)?
3. What part of a shaft is called a journal? 4. How many types of bearings can you mention? 5. What are they? 6. What types are antifriction bearings?

3. Choose the right variant.

1. Bearings with continuous rotary _____ form a great majority of all bearings.
a) angle b) force c) space d) motion
2. Journal bearings belong to the first _____.
a) group c) part d) class d) side
3. Bearings carry a load _____ at right angles to the shaft axis.
a) forcing b) acting c) producing d) rotating
4. A head of a rivet is an upset _____ of a rivet.
a) body b) top c) thread d) part
5. _____ wear can be reduced by providing a sufficient bearing area and by adequate lubrication.
a) excessive b) additional c) great d) much
6. Usually right-hand _____ are used in screw fastenings.
a) sides b) threads c) forms d) types

7. Rivets are used_____elements made of metals which are difficult to weld together.

a) to connect b) to effect c) to make d) to hold

4. Translate the text into English.

Підшипник – опора обертових деталей (*валів, осей*), що сприймає від них навантаження і забезпечує вільне обертання їх. Крім того, за допомогою підшипника підтримують деталі, які обертаються навколо валів та осей – *шків*, шестерні тощо. Залежно від виду *тертя* частин, що дотикаються, розрізняють підшипники ковзання і кочення.

За напрямом дії навантажень підшипники ковзання бувають радіальні і упорні; за режимом мащення – гідродинамічні і гідростатичні (між поверхнями тертя — шар рідкого мастила), а також газодинамічні і газостатичні (між поверхнями тертя – повітря або нейтральний газ). Підшипники ковзання виготовляють здебільшого з *антифрикційних матеріалів*.

Підшипники кочення поділяють за напрямом дії навантажень (радіальні, радіально-упорні, упорно-радіальні, упорні), за формою тіл кочення (кулькові, кулькові сферичні, роликові циліндричні та ін.) тощо. Кільця і кульки таких підшипників виготовляють із сталі, *сепаратори* — з сталі, латуні, бронзи або ін. матеріалів. У підшипника кочення менші втрати на тертя, ніж у підшипника ковзання. Їх найширше застосовують у машино- і приладобудуванні.

5. Make up a dialogue on the following topics using the Infinitive as well as the introductory and connective words.

1. Diversity of bearings and their operation. 2. Applications of bearings.

Text 3

1. Read and discuss the text.

Drives

Belt Drives. Belts can be used to transmit power from one shaft to another, and at the same time obtain a reduction or increase in r.p.m. As a rule the shafts are parallel; however, by proper design and at lower loads they can be placed at an angle.

Most flat belts used in industry are made of either duck or leather. Canvas or duck belts are protected from erosion by a rubber covering. For special conditions, fiat belts can be made from almost any material that can be bent around pulleys.

Under normal conditions, flat belts operate at speeds below 3000 ft./min and as high as 6000 ft./min. The critical speed of an installation is a function of the geometry of the installation, belt characteristics, and tension.

Leather has a tensile strength of 3000 to 4000 lb./sq. in. and is usually designed to a safety factor of 10, making the working stress 300 lb./sq. in. Leather belts are made in one, two, or three plies. Duck used in rubber-covered belts is graded by the weight in ounces of a strip 36 in. wide by 40 in. long.

All belt drives depend on the coefficient of friction to balance the tension differential between the slack and driving sides of the pulley. The power can be calculated from the following relationships:

$$K_s (hp.) = \frac{(F_1 - F_2)v}{3300}$$

where V = belt speed, ft./min.

K_s = service factor that varies from 1 for steady loads and up to 2 or more for shock loads or loads involving stalling F_1 = tensile force on driving side F_2 = tensile force on "slack" side.

The relationship between F_1 and F_2 depends on the angle of contact, the friction coefficient of the belt on the pulleys, and the centrifugal forces on the belt (as well as gravity with vertical drives) which tend to separate it from the pulley. The wedging action induced by the tensile forces on V-belts against the pulley grooves increases the contact load, and hence the friction of V-belts is two or three times that of flat belts, with resulting proportionally greater power transmission. In addition V-belts can use smaller pulley diameters than flat belts for the same power rating.

The theoretical speed ratio between driver and driven equipment for both flat and V-belts is essentially proportional to the diameter of the pulleys; however, because of slippage and creep, the actual speed ratio is not constant.

Variable-speed V-belt drives use adjustable cones to obtain variable pulley diameters and therefore adjustable speed.

Chain Drives. Chains and sprockets are used to obtain a fixed speed ratio by eliminating slippage or for power greater than is obtainable by belts.

Vocabulary

belt drive	ремінний привід
revolution	оберт
duck	брезент, технічне сукно
leather	шкіра
rubber covering	гумове покриття
flat	плаский

slack side	провисаюча сторона
steady load	постійне навантаження
stall	зупинитися
tensile force	сила натягіння
groove	доріжка
creep	повзти
rating	величина
sprocket	зубчасте колесо, зірочка

2. Translate the following text into English.

Привод – пристрій, що надає руху робочим машинам і механізмам. Основні частини приводу: *двигун* або ін. джерело енергії (наприклад, пружинний механізм); механічна *передача*, що передає енергію (рух) машині (механізму); ручна, напівавтоматична або автоматична система керування і захисту. До найпоширеніших належать одиночні (в тому числі індивідуальні) або багато-двигунові *електроприводи*. Розрізняють також приводи механічні (з двигунами внутрішнього згоряння, паровими турбінами та ін.), гідравлічні (з використанням рідини, стиснутої гідронасосом), пневматичні (в них використовується повітря, стиснуте компресором) і комбіновані. Приводи різних типів застосовують головним чином у промисловості і на транспорті. Крім машинних поширені приводи ручні (напр., в арифмометрах) і ножні (у велосипедах, швейних машинах тощо)

3. Make up a dialogue on the following topics using the Infinitive as well as the introductory and connective words.

1. Application of belt drives. 2. Requirements to belts. 3. Calculation of power of belt drives. 4. Other kinds of machine drives.

LIFTING AND TRANSPORTING MECHANISMS

UNIT 9

1. Learn the notions and their definitions.

Piston A rod or disk that can move up or down within a hollow cylinder.

Crankshaft A shaft driving or driven by a crank.

Efficiency A machine's ratio between work output and energy input.

Horsepower A measure used in the English-speaking countries for the work performed by a machine. It was devised in the eighteenth century by James Watt and equals 33,000 foot-pounds per minute.

Mechanical Advantage The ratio of the output force of a machine to the input force necessary to work the machine.

Text 1

2. Read, translate and retell the text.

Crane

Crane is a hoisting machine widely used for handling materials at building construction sites, factories, warehouses, and shipyards. Cranes move heavy loads by means of ropes or cables that ride over pulleys. Nearly all of them move loads both vertically and horizontally.

Machines that can only raise and lower loads are called *hoists*, or *winches*. Small cranes are operated by a hand crank, most large cranes are powered by electric motors or diesel engines. Originally large cranes were powered by steam engines.

Among the principal components of cranes is the jib, a horizontal or inclined beam with structural supports to prevent it from bending.

The jib supports either a fixed pulley system or a movable pulley system that can travel along its entire length. The jib is usually attached to a vertical pillar, or column, or a wall of a building about which it can be rotated. The jib is attached to the wall with brackets. The pulley system of ropes or cables are wound onto a drum, or cylinder, that is turned by a hand crank or a motor. Some cranes are mounted on stationary supports, while others are mounted on movable bases. Special cranes may have a variety of additional features.

Portable Jib Crane. The portable jib crane is small and is attached to the columns or walls of a building by means of simple adaptors. Portable jib cranes are particularly useful in various areas of shops and warehouses.

Cantilever Crane. This type of crane has a jib that extends outward from a supporting column that generally cannot be rotated. The jib is usually counterbalanced.

Traveling Cranes. There are several types of traveling cranes. One of the most common is the *traveling jib crane*. Its pulley system is suspended from a trolley that moves along the length of the horizontal jib. *Traveling bridge cranes* consist essentially of two elevated tracks that are bridged by a girder that travels along the tracks on wheels. *Gantry cranes* have a bridge that is supported at both ends by vertical columns, or legs. The legs are mounted on wheels or rollers so that the entire structure can move along rails or tracks.

Truck Crane. This type of crane is mounted on a truck that moves on large wheels or on tractor caterpillar treads. They are often called cranes, but are designed to travel on standard gauge tracks.

crawler cranes. Truck cranes are quite versatile because they are self-propelled and can be equipped with accessory booms, or jibs, to extend to about 150 feet (46 meters) high. *Locomotive cranes* are similar to truck

Floating Crane. Hoisting and transporting cargo to and from ships are often done with floating cranes, which are mounted on pontoons or barges. Floating cranes are also used for water work such as driving piles and raising sunken vessels and other objects.

Cable Crane. Materials such as earth and rocks are often lifted and transported by cable cranes. The load is carried in buckets attached to a cable that moves between two towers.

Vocabulary

hoist, winch, raise	піднімати
handle	мати справу з
warehouse	склад
construction site	будівельний майданчик
shipyard	док
load	вантаж
hand crank	заводна ручка, важіль
attach	прикріпляти
bracket	скобка
jib crane	кран із стрілою (поворотний)
trolley	контактний ролик
counterbalance	противага
girder	балка, мачта, ферма
cantilever crane	кронштейний кран
gantry crane	портальний кран
truck / <i>crawler</i> crane	автокран
caterpillar treads	гусеничні ланки
self-propelled	самоходний
accessory boom	додаткова стріла

rail	рейка
gauge tracks	колійні путі
floating crane	плавучий кран
drive piles	забивати палі (рос. сваї)
sunken vessel	занурений посуд
bucket	ківш
tower	башта

2. Discuss cranes, their lifting operations. Introduce the questions and answers.

1. Have you ever seen any kind of crane? Where? What did it look like? Can you describe it or them? 2. Which cranes may be used indoors and which outdoors and why? 3. What principal parts is a crane composed of? 4. What do all cranes have in common and what distinguishes them. 5. What are the advantages and disadvantages of different cranes?

3. Ask your own questions on the text

4. Find in the text the equivalents of the Ukrainian words and expressions.

підйомна машина, працювати з матеріалами, піднімати та опускати, будівельний майданчик, пересувати важкі вантажі, запобігати згинанню, нахилена балка, система рухомих блоків, може обертатися навколо, прикріплений до вертикального стовпа, скоба, накручений на барабан, особливо корисний, площини складів, піднесені рейки.

5. Fill in the gaps.

raise, travel, brackets, ride, hoisting, powered, operated, lower, mounted, principal, loads, attached, bending, wound.

Crane is a _____ machine widely used for handling materials at building construction sites, factories, warehouses, and shipyards. Cranes move heavy _____ by means of ropes or cables that _____ over pulleys. Machines that can only _____ and _____ loads are called *hoists*, or *winches*. Small cranes are _____ by a hand crank, most large cranes are _____ by electric motors or diesel engines. Among the _____ components of cranes is the jib, a horizontal or inclined beam with structural supports to prevent it from _____. The jib supports either a fixed pulley system or a movable pulley system that can _____ along its entire length. The jib is usually _____ to a vertical pillar, or column, about which it can be rotated. In some cases a wall of a building can serve as the pillar. The jib is then attached to the wall with _____. The pulley system of ropes or cables are _____ onto a drum, or cylinder, that is turned by a hand crank or a motor. Some cranes are _____ on stationary supports, while others are mounted on movable bases.

6. Describe: a) the application of cranes.

Example. Cranes are used to hoist loads.

jib crane, cantilever crane, gantry crane, truck crane caterpillar /crawler crane, floating crane, duck crane.

b) the composition of cranes.

Example. Crane is known to be composed of many details.

accessory boom, rail, gauge tracks, counterbalance, girder, hand crank, bracket, driving pile, bucket, tower, checkout stand.

7. Use the words with the same root in situations.

elevate – elevation – elevator, move – movable – motion, travel – travelling – traveller, locate – location – dislocate, mount – mounted – mountain.

8. Ask smb where he / she has seen the following writings or corresponding signs and what they mean.

Danger! Beware! Caution! Take care! High voltage! Explosive! No parking! Mind the boom!

9. Group the synonyms and use them in situations.

lift, machine, raise, jib, travel, perform, go, apparatus, support, arrow, lower, hoist, place, road, mechanism, rail, path, mount, runway, move, track, assemble, pick, suspend, rout, do, boom, hang, ride, column, operate, elevate, act, beam, work, pillar, location, device, descend, appliance, way, bar, installation.

10. A. Finish the sentences with the Infinitive.

Model 1. noun + Infinitive. He knows a right person to talk to.

1. It's a nice job _____. 2. It wasn't my fault not _____. 3. It is a grand idea _____. 4. They have a useful project _____. 5 They need a spare detail _____.

Model 2. adjective + Infinitive. He's too young to have done it.

I'm (terribly) sorry / tired / unexperienced / busy / clever / efficient / intelligent / reliable / kind / competitive / responsible / organised enough / rather curious _____.

Model 3. pronoun / adverb + Infinitive. There is nothing to do.

1. Do you suggest anything _____. 2. Is there anyone _____ ? 3. There was a lot _____. 4. They had little _____. 5. There will be much _____.

B. Make up sentences after a model.

Model 1. seem + Infinitive. The process seems to go right.

Model 2. verb + infinitive.

1) I want / expect / hope / remember / forget / make smb / allow me / am able / have to do something / to have / get it done / made, I should confess / admit / didn't realize to have done it, let me / may / must / could (I) do it (?).

2) It needs / will have to be done.

3) 1. I would like / would rather go there. 2. I'd rather (she, he, she you, they, we) went there, didn 't go there.

11. Translate the following text into English.

Підйомний кран — машина періодичної дії, що нею піднімають і переміщують на невелику віддаль вантажі. Основними складовими частинами підйомного крану є: несучі конструкції (мостова або консольна *ферма*, башта, *щогла*, стріла), головний вантажопідйомний механізм (*лебідка*, *тельфер*), *силова установка*, електроустаткування, напрямні й підтримуючі елементи (ланцюги, канати) та вантажозахватні пристрої (гак, *електромагніт*, *грейфер* тощо).

За конструктивними ознаками і схемою дії розрізняють підйомні крани стаціонарні й пересувні; поворотні й неповоротні. В свою чергу, поворотні підйомні крани поділяють на залізничні, велосипедні (з рейками на різних рівнях), пневмоколісні, автомобільні, гусеничні, настінні й покрівельні. Є також поворотні (на самохідних *понтон*ах) і суднові (на судах). Поворотна частина підйомного крану спирається на *портал* (портальний кран), рухому або нерухому колону чи поворотний круг. В деяких машинах вона має вигляд башти (баштовий кран) або щогли (щоглово-стріловий кран). До неповоротних належать: крани мостові — з котючою мостовою фермою, що переміщується по рейках, укладених на підкранові балки (найпростіший кран такого типу — кран-балка); крани перевантажувальні (*мостові перевантажувачі*, козлові, кабельні) та настінно-консольні. Є також неповоротні плавучі крани. У важкодоступних місцевостях застосовують вертольоти-крани.

Основна характеристика підйомного крану — *вантажопідйомність*, що у деяких кранів (наприклад, плавучих неповоротних) становить 1500–2500 т. Найпростіші підйомні крани з ручним приводом

ВИГОТОВЛЯЛИ (до кінця 18 ст.) з деревини.

12. Make up a dialogue on the following topics using the Infinitive as well as the introductory and connective words.

1. Variety of cranes. Their principal parts. 3. Their distinctive features.

13. Consider the notion and it's definition and tell what you know on the topic.

The Integral

The first basic concept of the calculus is that of integral. In this article we shall understand the integral as an expression of the area under a curve by means of a limit. If a positive continuous function $y = f(x)$ is given, e. g. $y = x^2$ or $y = x^2 + \cos x$, then we consider the domain bounded below by the segment on the x -axis from a coordinate a to a greater coordinate b , on the sides by perpendiculars to the x -axis at these points, and above by the curve (see Fig. 27).

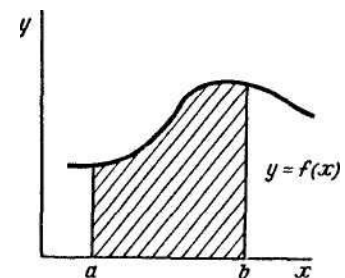


Fig. 27

$$y=f(x).$$

The integral as an area.

Our aim is calculating the area A of this domain. Since such domain cannot, in general, be decomposed into rectangles or triangles, no immediate expression of this area A is available for explicit calculation. But finding an approximate value for A is possible, and thus we can represent A as a limit in the following way: by subdividing the interval from $x = a$ to $x = b$ into a number of small subintervals.

It can be done by erecting perpendiculars at each point of subdivision, and by replacing each strip of the domain under the curve by a rectangle. The height of those rectangles is chosen somewhere between the greatest and the least height of the curve in that strip.

The sum S of the areas of these rectangles gives an approximate value for the actual area A under the curve.

Text 2

1. Read the text and classify conveyers. Translate the text.

Conveyer

Conveyer (Amer. conveyor) is a device for moving loads from one point to another over fixed paths. Conveyors are used throughout industry in nearly every phase of production and distribution, since they promote economy by providing a controlled continuous flow of materials. The conveyor has become a symbol of mass production. There are about 130 different types of conveyors.

Nonpowered Conveyors. The simplest types of conveyors are those that use gravity or manual power to propel the objects. The most common nonpowered conveyors are chutes, roller conveyors, and wheel conveyors.

Chutes. Certain bulk materials, such as coal and gravel, and some solid objects that are not free flowing can be directed and lowered by gravity in troughs called chutes. Chutes are usually used for short moves, such as from one machine to another or from one floor to another.

Objects are advanced by gravity or manually on *roller conveyors*, which consist of a series of rollers supported in a frame. *Inclined roller conveyors* depend on rolling friction to control the speed of descent of the materials. Roller conveyors are extremely common in package-handling

operations. *Wheel Conveyors* are similar to roller conveyors but have skate-type wheels mounted on parallel bars.

Powered Conveyors. Most conveyors use power to move materials, and employ a belt, chain, or cable to provide the material movement.

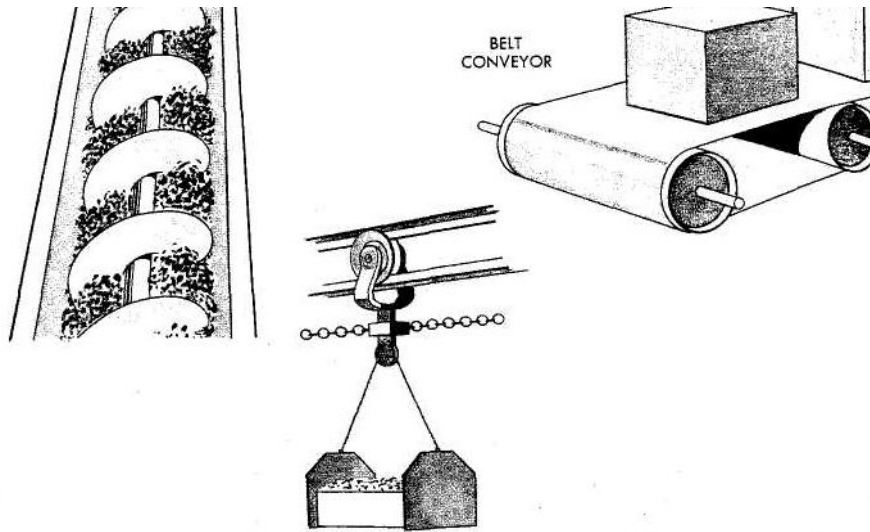
Belt Conveyors consist essentially of an endless belt of fabric, rubber, plastic, leather or metal. The belt is supported on rollers, troughing idlers, or a flat slider bed and passes over a drive and end pulley. Loads such as cartons, bags, and boxes are carried on the belt. In *Live-Roller Conveyors* rollers are power driven. *Apron Conveyors* consist of a number of overlapping steel plates, aprons, or pans, attached at their ends to two strands of chain that run in steel guides, and consists of wood or metal slats attached at their ends to two sliding chains. *The slat conveyor* is a variation of the apron conveyor. *Bucket Conveyors* carry materials in buckets mounted on an endless belt or on one or two chains. *Flight Conveyors.* In flight conveyors, flight or scrapers are attached at spaced intervals to one or more endless chains or cables. Flight conveyors are generally used to push bulk materials along a trough.

Trolley Conveyors. Trolley conveyors consist of a series of trolleys that are supported by a single overhead track. They are connected to and propelled by a chain, cable, or other linkage. The loads are usually placed in carriers that are suspended from the trolleys

Power-and-Free Conveyors. The power-and-free conveyor is a system in which the load is moved in carriers that are supported by a single rail (monorail). The carriers are connected to and propelled by a trolley conveyor that is directly above the "free" rail.

Floor conveyor is commonly used in automobile industry. *Tow Conveyors* pull floor-supported trucks or carts. A *chain conveyor* pushes logs under jets of water for cleaning before processing at a newsprint mill. *The screw conveyor* can have its flights so shaped that it

mixes materials while conveying them.



screw conveyer

chain conveyer

belt conveyer

Fig. 28

Vocabulary

propel, convey	рухати
chute	спуск, лоток, желоб
descend	опускати
troughing idlers	проміжні шестерні канавки
flat slider bed	пласка ковзаюча поверхня
bulk materials	об'ємні матеріали
trough	желоб, лоток
overlapping	перекривати
apron	фартук
pan	лоток, піддон, ківш
strand	стренга тросу, кабеля
guide	спрямовуючий прилад, куліса,

	передавальний віжіль
slat	планка, перекладина
checkout stand	контрольна стойка, консоль, підпорка
flow	потік
pick	вибирати

2. Ask questions on the text.

3. Translate the following text into English.

Конвейєр

Конвейєр (англ. conveyer від convey – перевозити, переміщувати, транспортувати – машина (пристрій), якою безперервно з завданням ритмом переміщують (транспортують) вантажі чи вироби на невелику, а іноді й на значну відстань. До найпоширеніших належать механічні конвейєри, рух яким надає машинний (переважно електричний) *привод*. Такі конвейєри з тяговим органом (стрічкою, ланцюгом, канатом), яким і переміщуються вантажі або вироби (залежно від типу вантажного органа) бувають стрічкові, скребкові, з програмним керуванням, штовхаючи, пластинчасті, підвісні, ківшові, візкові та ін.

Механічні конвейєри без тягового органа поділяють на гвинтові, інерційні (хитні, вібраційні), роликові, крокуючі (ливарні, складальні) тощо. Є також гравітаційні (напр., *гвинтові спуски* – з рухом вантажів або виробів під впливом власної ваги; гідравлічні, що являють собою труби або лотоки, де вантажі переміщуються разом з рідиною головним чином за допомогою насосів (вуглесосів, бурякососів тощо), і пневматичних у вигляді труб, в яких рух вантажів або виробів зумовлюється перепадом тиску повітря, створюваним вентиляторами.

До спеціалізованих конвейерів належать *елеватори, ескалатори* та ін. Створені магнітодинамічні конвейери, якими переміщують (по трубах, потоках) розплавлений метал, використовуючи електромагнітні, індукційні насоси.

Конвейер — важливий засіб комплексної *механізації і автоматизації виробництва*, його використовують у машинобудуванні, металургії, у гірничій, хімічній та ін. галузях промисловості.

4. Speak in dialogue on the following subjects using the infinitive complexes as well as introductory and connective words.

1. Kinds of conveyers. 2. Their distinctions in construction. 3. Different conveyers utilization. 4. The physical laws used in conveyers. 5. The purpose of the following conveyers' parts: rollers, troughing idlers, flat slider bed, drive, end pulley.

FOOD INDUSTRY EQUIPMENT

Unit 10

Text 1

1. Read, translate and retell the text.

Mechanical Apparatuses. Roll mill

Roll mills may contain one, two, or three rolls and can be arranged for either batch or continuous production. The supply of material is cradled between the rolls or between the roll and a feed bar, where it is kneaded and folded. Part of the material is nipped and continuously drawn down between the rolls or between the roll and the feed bar where it is subjected to crushing, shearing, and abrasion. This action calls for the proper formulation as sufficient

liquid must be provided to wet the constantly increasing surface of the dispersed material. This is necessary both to lubricate the particles as they pass through the mill and to avoid the formation of new agglomerates. Since all the broken or dispersed particles in the thin film must be immediately surrounded with a film of vehicle, the feed to the mill must be uniform and not contain lumps of dry material. Change-can mixers may be used for preliminary dispersion.

The roll or rolls may be heated or cooled as required. As the action varies with the number of rolls, the different types will be considered separately.

The single-roll mill contains a wide-faced grinder bar working against a smooth hardened roll. Practically all the work done in single-roll mills results from abrasion. The nipping action is much weaker than between two rolls rotating in the same direction at the point of contact, and there is less crushing than in a two-roll mill. The larger contact area of the rubbing bar and the roll gives more hydraulic shear than in two- or three-roll mills. As the nip is weak, coarse material collects in the feed between the grinding bar and the roll. This action may change the composition of the product.

Accordingly, single-roll mills are best considered for dispersion rather than grinding. Also, they cannot efficiently handle materials of a wide range of viscosity. Mixes which are too thin are not pulled into the narrow space between the grinder bar and the roll, while pastes which are too heavy bridge the nip entrance.

Two-roll mills contain two parallel rolls mounted in a heavy frame with provision for accurately regulating the pressure and distance between the rolls. They are usually mounted in the same horizontal plane. As one pass between the rolls does little blending and only a small amount of work, they are practically always used as batch mixers.

To increase the wiping action, the rolls are usually operated at different speeds. The material passing down between the rolls is returned to the feed

point by the rotation of the rolls. If the rolls are at different temperatures the material will usually stick to the hotter roll and return to the feed point as a thick layer.

Vocabulary

roll mill	валковий млин
batch production	серійне виробництво
supply	постачати
cradle	подається
knead and fold	місити та складати
feed bar	рухома щока
crush	роздавлювати
shear	різати
abrasion	розтирання, подрібнення
wipe	розтирати
agglomerates	накопичення
change-can	зі змінним сосудом
preliminary dispersion	попереднє розсіювання
grinder bar	щока дробарки
hardened roll	прокатний валок
nip entrance	отвір захвату, зажиму
dense media	густе середовище

2. State whether the following statements are true or false and comment on them.

1. Roll mills may contain two, or three rolls. 2. Between the roll and the feed bar the material is subjected to crushing, shearing, and abrasion. 3. Liquid must be provided to wet the constantly decreasing surface of the dispersed material. 4. It is necessary to lubricate the particles. 5. The feed to the mill

must not be uniform.

3. Complete the sentences.

1. The single-roll mill contains _____. 3. There is less crushing in the single-roll mill _____. 4. Accordingly, single-roll mills _____. 5. Also, they cannot _____. 6. *Two-roll mills* contain _____. 7. Separatory-vessels are used _____. 8. The latter include _____.

4. Ask question on the text.

5. Find in the text the equivalents of the Ukrainian words and expressions.

розмелювати (2), місити, забезпечувати, постійно зростати, змащувати деталі, проходити (пропускати) через млин, підлягати подрібненню, тонка плівка, твердий / рідкий / сухий / вологий матеріал, режим змішування, гвинт, передача енергії, потік рідини, містити, накачувати насосом, накопичуватися, ефективно працювати з матеріалом, висока в'язкість, призначений для, змінити склад продукту, цистерна, однороловий млин, тягнути (2).

6. Fill in the blanks.

vehicle, considered, dispersed, grinder bar, lubricate, rubbing, feed, shearing, abrasion, crushing, nipped, kneaded, supply, batch.

Roll mills may contain one, two, or three rolls and can be arranged for either _____ or continuous production. The _____ of material is cradled between the rolls or between the roll and a feed bar, where it is _____ and folded. Part of the material is _____ and continuously drawn down between the rolls or between the roll and the _____ bar where it is subjected to _____, _____, _____. This action calls for the proper formulation as sufficient liquid must be provided to wet the constantly increasing surface of the _____ material. This is

necessary both to ____ the particles as they pass through the mill and to avoid the formation of new agglomerates. Since all the broken or dispersed particles in the thin film must be immediately surrounded with a film of ____, the feed to the mill must be uniform and not contain lumps of dry material. *The single-roll mill* contains a wide-faced ____ working against a smooth hardened roll. The larger contact area of the ____ bar and the roll gives more hydraulic shear than in two- or three-roll mills. Accordingly, single-roll mills are best ____ for dispersion rather than grinding. Also, they cannot efficiently handle materials of a wide range of viscosity.

7. Define the notions.

dispersion, abrasion, agglomerate, preliminary, media, viscosity.

8. Group the synonyms and use them in situations

constant, speed, damp, mill, fix, grease, various, draw, fluid, enterprise, item, numerous, knead, treat, be composed of, accumulations, receive, revolve, liquid, equipment, permanent, pull, mount, velocity, provide, mix, include, lubricate, process, ready, feed, grind, oil, construct, continuous, addition, wet, principal, turn, agglomerates, consist of, obtain.

9. Group the antonyms.

low density, internal, inner, intensively, timely, high density, external, extensively, continuous.

10. A. Define the word with the same root and use them in situations.

mix – mixer – mixing – mixed, revolve – revolving – revolution – revolver, design – designer – designing, construct – construction – constructor – constructive, agitate – agitation – agitator.

11. A. Use the Gerund to describe the milling operations.

Model. The material is subject to processing.

mill, treat, mix, knead, fold, nip, draw, crush, shear, abrase, disperse, grind, blend, press, wip, separate.

B. Use the gerund as well as the connective words below to make contradiction or agreement about the useful properties of mills as the domestic technoque.

aside from, apart from, except from, for the exception of, along with, together with, besides, it should be / have, I would

12. Use gerunds or participles instead of the subordinate clause.

1. We are sure that they will solve this problem. 2. We insisted that they inform us about it. 3. A laser is a device that produces light in an entirely different way from that of an Incandescent lamp. 4. Excuse me that I am so late. 5. Since aluminium does not rust it has been found useful in the building industry. 6. It is worth while that I remember this rule. 7. He left Kyiv six month ago, and I have not seen him since. 8. When we use this device, we are able to make new kinds of experiments. 9. When we use a dictionary we can translate the article. 10. After we received a telephone call from his friend, he sent him a telegram.

13. Insert the modal verbs should, would.

1. Today man ____ put his knowlege of atomic energy only to peaceful uses. 2. Without metals we ____ have no huge building, bridges. railroads, automobiles and many tools needed to make all kinds of machinery. 3. The launching of space rockets ____ not have been possible without the necessary polymeric materials. 4. One ____ know the properties of metals. 5. Plastics ____ be used where an insulation propery is required. 6. Without plastics it ____ be impossible to build spaceships.

14. Translate the text into English.

Дробарки

Дробарки поділяються за ступенем подрібнення на дробарки для грубого, середнього і дрібного подрібнення та млини для тонкого і колоїдного подрібнення. За способом подрібнення розрізняють машини:

1) розколювальні і розламувальні; 2) роздавлювальні; 3) розтирально-роздавлювальні; 4) ударні; 5) ударно-розтиральні; 6) колоїдні. Для харчових виробництв характерна широка різноманітність використаної вихідної сировини. Різні фізико-механічні властивості матеріалів, ступінь подрібнення, форма та однорідність частинок потребують розроблення і застосування різних конструкцій подрібнювачів.

До дробарок розколювально-роздавлювальних належать щоківі й конусні. *Щоківі дробарки* застосовують при грубому і середньому дробленні будівельних матеріалів, вапнякового каменю в цукровому виробництві. Матеріал подрібнюють роздавлюванням і розколюванням між нерухомою і рухомою щоками дробарки, які утворюють робочий об'єм. Під час обертання вала з ексцентриком шатун переміщується у вертикальній площині. Шатун шарнірно з'єднаний розпірними плитами з рухомою щокою, внаслідок чого здійснюється коливальний рух щоки навколо осі. Матеріал надходить у верхню частину простору, що утворений нерухомою і рухомою щоками. Під час робочого ходу, коли відстань між щоками зменшується, матеріал подрібнюється. Під час холостого ходу шатуна щока відводиться тягою з пружиною і подрібнені шматки провалюються крізь нижню щілину. Ширина розвантажувальної щілини, що характеризує ступінь подрібнення, регулюється за допомогою рухомого клина і гвинта, які закріплені на станині. Обидві щоки, які безпосередньо контактують з матеріалом, що

подрібнюється, обладнані розбірними плитами з міцного відбіленого чавуну або марганцевої сталі з рифленням. Запобіжним пристроєм є розпірні плити, що розраховані з меншим запасом міцності. Вал з'єднаний з маховим колесом, яке сприяє усталеній роботі дробарки під час дроблення.

Продуктивність дробарки визначається певною частотою коливань щокі. Щоківі дробарки прості за конструкцією, компактні, надійні в роботі, але вони мають холостий хід. Великі коливальні маси створюють шум і вібрацію.

Text 2

1. Read the text, prepare an abstract with the key words.

Hydromechanic processes and apparatus. Mixing Equipment

Mixtures of solids and liquids are blended in a variety of equipment types, depending on the physical characteristics of the mixture. Relatively thin, pumpable suspensions are usually handled in *tanks* agitated with an impeller or fluid jet; non-flowing pastes are handled in slow-speed non-circulating mixers.

For many medium-duty mixing applications, requiring up to 3 hp., the *fixed-mounted propeller mixer* shown in Fig. 29 is used. Such mixers are also mounted, as a rule, angularly off center to give top-to-bottom flow. They have the same speed ranges as portable mixers. They may be equipped with stuffing boxes or mechanical seals if the tank must be closed. Since propellers turn at relatively high speeds, the drive required for a given power transmission is not expensive. *Top-entering propeller mixers*, however, cannot deliver more than about 3 hp., and the shaft length is limited to a maximum of about 6 ft.

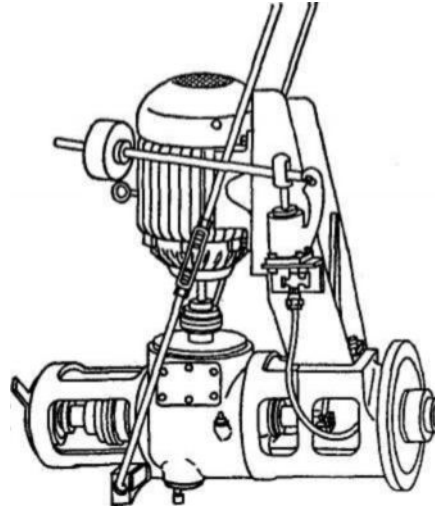


Fig. 29. Typical fixed-mounted propeller mixer.

Side-entering propeller mixers (Fig. 29) are used most commonly on applications where abrasive slurries are not present. Seals and stuffing boxes are best avoided if possible.

Anchor and gate impellers either sweep the tank bottom or, more commonly, sweep the entire peripheral area of the tank in contact with the fluid. They are normally used where it is desired to have a close clearance between the impeller and the tank wall.

Most large-scale mixing of solid-liquid suspensions is done with *top-entering turbine or paddle agitators*.

Solid-Solid Mixing Equipment. There are several basic mechanisms by which solid particles are mixed. These include small-scale random motion (diffusion), large-scale random motion (convection), and shear. There are several types of solids-mixing machines. In some machines the container moves. In others a device rotates within a stationary container. In some cases, a combination of rotating container and rotating internal device is used. Sometimes baffles or blades are present in the mixer.

Tumbler is suitable for gentle blending; capable of handling large volumes; easily cleaned; suitable for dense powders and abrasive materials. Not for breaking up agglomerates.

Vocabulary

solid	твердий
blend	суміш
pumpable	накачувана
tank	цистерна
agitate	розмішувати
fluid jet	струмінь рідини
propeller	гвинт
stuff box	набивна камера, сальник
abrasive slurry	абразивна грязь
vehicle	розчинник

2. Complete the sentences.

1. *Mixtures of solids and liquids* are blended _____. 2. Relatively thin, pumpable suspensions are usually handled _____. 3. For many medium-duty mixing applications _____. 4. Such mixers are also mounted _____. 5. *Side-entering propeller mixers* are used _____. 6. *Anchor and gate impellers* either sweep _____. 7. They are normally used _____. 8. . Most large-scale mixing of solid-liquid suspensions is done with _____. 9. *Solid-Solid Mixing Equipment* include _____. 10. In some machines _____. 11. In some others _____. 12. *Tumbler* is suitable for _____.

3. Ask question on th text.

4. Write an abstract of the text and learn it by heart.

5. Translate the following text into English.

Мішалки

Найбільш універсальними для перемішування при турбулентному режимі руху з метою переважного вирівнювання концентрацій і температур є лопатеві, пропелерні та турбінні апарати з мішалками, що створюють одночасно макро- і мікропотоки. В лопатевих апаратах переважає колова складова швидкості руху, в пропелерних і турбінних відповідно зростають аксіальна і радіальна складові.

Лопатеві мішалки найпростіші за будовою. Це закріплені на вертикальному або горизонтальному валу лопаті, встановлені перпендикулярно або під кутом до напрямку руху. Кількість лопатей або їх рядів по висоті також різні, як і форма самих лопатей. Будова лопатей визначається фізичними властивостями перемішуваного середовища.

Звичайні лопатеві мішалки (рис.) найбільш придатні для перемішування малов'язких рідин (до $0,1 \text{ Па} \cdot \text{с}$). Частота їх обертання $0,4 \dots 1,5 \text{ с}^{-1}$ і не перевищує $6,5 \text{ с}^{-1}$. Перевагою лопатевих мішалок є простота їхньої будови. Проте вони не забезпечують інтенсивного перемішування в радіальному та осьовому напрямках.

Пропелерні мішалки мають робочий орган у вигляді ґвинта (пропелера), насадженого на вертикальний або горизонтальний вал. Ґвинти бувають дво- і трилопатевими. Діаметр ґвинта становить від $1/3$ до $1/4$ діаметра посудини. Завдяки зміні кута нахилу лопатей по їхній довжині частинки рідини відштовхуються ґвинтом у багатьох напрямках, що забезпечує кращу циркуляцію рідини. Пропелерні мішалки доцільно використовувати для макроперемішування рухливих рідин з коефіцієнтом динамічної в'язкості до $0,6 \text{ Па} \cdot \text{с}$. Порівняно з лопатевими мішалками пропелерні ефективніші, але вони потребують більше енергії.

Перемішування рідких середовищ переважно на мікрорівні потребує створення турбулентних пульсацій малого масштабу. Для цього використовують якірні, турбінні мішалки в посудинах з відбивними перегородками, вібраційні, кавітаційні, ультразвукові та ін. Турбінні мішалки мають робочий орган — турбіну, яка встановлена на вертикальному чи горизонтальному валу, що обертається з частотою $3,5...35,0 \text{ c}^{-1}$. Розрізняють турбіни закритого і відкритого типу. За будовою і принципом дії закриті турбіни нагадують робоче колесо відцентрового насоса. Якірні мішалки використовують, щоб запобігти місцевому перегріванню рідини біля нагрівних стінок або осаду на дні посудини

6. Discuss: 1. The kinds of mixers. 2. Performance characteristics of different kinds of mixers.

7. Prepare a presentation of food equipment according to the example below including formulae, illustrations – advertisements of all kinds: leaflets, prospects, etc.

Allow me to present you a modern ____ . It is widely used / applied in / is necessary for ____ . It provides ____ . It is produced ____ . It has advantage over ____ . It provides continuous work ____ . Creates little (no) friction. Works under the worst conditions. Requires little lubrication. It is available in a broad assortment with accessories attached in dimentions ____ . You can buy / order and receive / it at ____ .

Unit 11

Text 1

1. Read, translate and retell the text.

Hydraulics. Momentum Transfer.

Pumps

Pumps of various kinds are required everywhere. A fundamental knowledge of basic types of pumps and their exploitation are of great importance for an engineer. The conditions that will influence the selection of the type of the pump are: the type of liquid to be handled; that is its viscosity; cleanliness, temperature and so on; the amount of liquid to be handled; the total pressure against which the liquid is to be moved; the type of power to be used to drive the pump.

Pumps may be divided into four major classifications: piston pumps or reciprocating pumps. These pumps are driven by engines or electrical motors; centrifugal pumps driven by steam turbines or electric motors; rotary pumps driven by steam turbines or electric motors; fluid-impellent pumps which are not mechanically operated but are fluid-pressure operated.

The centrifugal pumps is one of the simplest types. It consists of an impeller spinning in a circular casing. It is cheap, occupies very little space, runs for long periods takes little attention and possesses other good qualities. The centrifugal pumps have the disadvantages that their output is effected by changes in pressure on the delivery side and they are not suitable for viscous liquids.

Unlike the centrifugal pumps, piston and plunger pumps are constant output machines. Plunger pumps are generally used for high pressures and

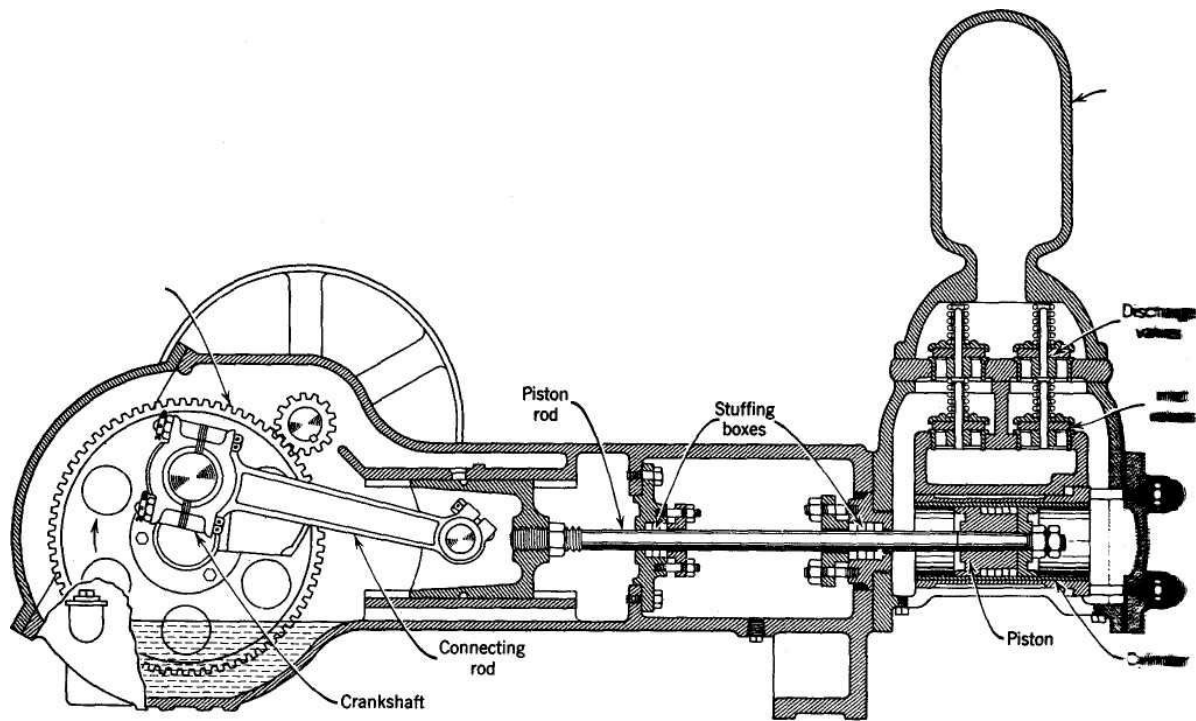


Fig.30. Cutaway view of a simplex piston pump.



Fig.31. Peristaltic pump.

piston pumps for lower pressures.

Pumps may be classed into two main groups, *positive-displacement* pumps and *centrifugal* pumps. Positive-displacement pumps may be either a reciprocating type or a rotary type. The prime feature of a positive-displacement pump is that a definite quantity of liquid will be delivered for each stroke or revolution of the prime mover. Only pump size, design, and suction conditions will influence the quantity of liquid that can be delivered. On the other hand, a centrifugal pump can deliver a variable volume of fluid with varying head for a constant speed.

Positive-Displacement Pumps. Principles of Unit Operations.

Reciprocating Pumps. Figure 30 illustrates a simplex *power-driven piston pump*. In this type of pump, the piston is connected to a suitable crank shaft which is driven by an electric motor. *Steam-driven pumps* are also used in the process industry.

In these pumps, liquid enters the cylinder through a check valve which is opened by an external pressure acting on the fluid. The flow of the fluid through the inlet valves follows the piston movement backward through the cylinder on its inlet stroke. When the piston moves forward, the inlet valve closes, and a second valve is forced open to discharge the liquid. The piston must have a close fit with the cylinder walls in order to minimize liquid slip past the piston. If the piston carries with it its own packing, it is called a piston pump. In contrast to this, a plunger pump uses a close-fitting rod moving through the cylinder past fixed packing. The plunger is simply an extension of the shaft. A volumetric efficiency may be defined as the ratio of actual discharge to the discharge based upon piston displacement. The efficiency for well-maintained pumps should be at least 95 per cent.

Reciprocating pumps are particularly well suited for pumping viscous fluids because the high rate of shear acting on the cylinder walls serves as an additional "packing." This pump is also good for attaining high pressures, and,

because of its positive-displacement characteristic, it is sometimes used for metering fluids. Liquids containing abrasive solids should not be pumped with a reciprocating pump because of damage to the machined surfaces.

Notes. Fluid-impellent pump – рідинний насос; to be fluid-pressure operated – працювати під тиском рідини; to run – працювати.

Vocabulary

fluid impellent pump	рідинний насос
impeller	робоче колесо
casing	картер
spin	крутитися
piston pump	поршневий насос
vessel	ємність
suction conditions	умови всотування
deliver	постачати
discharge	викид
check valve	стопорний / контрольний клапан
inlet / outlet stroke	крок впуску / випуску
close fit with	тісно прилягати до
external agitator bar	зовнішній важіль мішалки
shell	кожух
blow	удар
preordained pressure	завданий тиск
slurry	грязь
funnel	воронка, раструб
diatomaceous-earth	
precoat	обкладка діатомовою землею

2. Complete the sentences.

1. Pumps of various kinds _____. 2. The conditions that will influence the selection of the type of the pump are: _____. 3. Pumps may be divided into four major classifications: _____. 4. These pumps are driven by _____. 5. *The centrifugal pumps* is _____. 6. It consists of _____. 7. The centrifugal pumps have the disadvantages: _____. 8. Unlike the centrifugal pumps, piston and plunger pumps are _____. 9. Plunger pumps are generally used for _____. 10. Pumps may be classed into two main groups, _____.

3. Translate and answer the following questions.

1. Які бувають види насосів? 2. Які умови впливають на вибір насосов? 3. Чим приводяться в дію поршневі насоси? 4. Які насоси приводяться в дію електрикою? 5. Які недоліки мають центрофужні насоси? 6. Які насоси належать до машин безперервної дії? 7. Для яких тисків використовуються плунжерні та поршневі насоси?

4. Write an abstract of the text.

5. Find in the text the equivalents of the Ukrainian words and expressions:

поршневій насос, чистота, в'язкість, вид рідини, працювати під високим (низьким) тиском, приводити в дію, використовувати енергію, парова турбіна, двигун, центрофужний насос, з механічним управлінням, найпростіший вид, складається з, дешевий, займає мало місця, продуктивність, працює довгий час, плунжерний насос, головна риса, рухатися вперед / назад, впускний / випускний клапан, зовнішній / внутрішній тиск, розмір, конструкція, кількість рідини, круглий кожух, зменшити протікання рідини повз поршень, рухається через циліндр, переробна промисловість, звичайний стрижень, всотуючий бік насоса, використовуючи насоси, падаючий тиск, видалений газ, потреба у.

6. Fill in the blanks.

disadvantages, valve, viscous, stroke, spinning, qualities, handled, casing, runs, fluid-impellent, output, reciprocating, pressure, discharge, driven, selection required.

Pumps of various kinds are ____ everywhere. The conditions that will influence the ____ of the type of the pump are: the type of liquid to be ____; that is its viscosity; cleanliness, temperature and so on. Pumps may be divided into four major classifications: piston pumps or ____pumps. These pumps are ____by engines or electrical motors; centrifugal pumps driven by steam turbines or electric motors; ____ pumps (2) which are not mechanically operated but are fluid-pressure operated (3). *The centrifugal pumps* is one of the simplest types. It consists of an impeller ____ in a circular _____. It is cheap, occupies very little space, ____ for long periods (4) takes little attention and possesses other good _____. The centrifugal pumps have the ____ that their output is effected by changes in ____ on the delivery side and they are not suitable for ____ liquids. Unlike the centrifugal pumps, piston and plunger pumps are constant ____ machines. In these pumps the flow of the fluid through the inlet ____ follows the piston movement backward through the cylinder on its inlet _____. A volumetric efficiency may be defined as the ratio of actual ____ to the discharge. based upon piston displacement.

7. Group the synonyms and use them in situations.

drive, fluid, work, continuous, outlet, housing, impeller, operate, damage, achieve, ruin, attain, discharge, liquid, run, quantity, delivery, casing, output, efficiency, amount.

8. Give the derivatives of the words and use them in situations.

exploit, select, handle, rotate, viscose, clean, press, move, classify, centrifuge, impel, case, advantage, suit.

9. Complete the sentences using the Conditional Mood to select or recommend equipment for your food plant.

1. I should say, that _____. 2. If you need _____. 3. If we could _____ we would _____. 4. I would recommend _____. 5. I dare say _____. 6. You must be able to _____. 7. It must be _____. 7. We have to _____. 8. We are to _____. 9. I wish we might _____. 10. We ought to _____. 11. It might / could be _____.

will influence the selection, have some disadvantages, require conditions, well suited for, serves as, favourable, liquid, viscosity; high cleanliness, temperature, amount / quantity, deliver, attain high pressures, the type of power, used in the process industry, drive the pump, size, design, suction conditions, cheap, occupy very little space, run for long periods, take little attention, possess other good qualities, essential, particularly valuable, demands are likely to vary, makes them more desirable, an estimate of their cost, is not necessary, is available.

10. a) Add-*ing* wherever necessary and say whether it is gerund or participle.

1. Choos_____ a pump we should read its specification. 2. The compressor was stopping due to the decreas_____ power. 3. They began pump_____ out the water. 4. Degas_____ the liquid is another advantage of the pump. 5. Control_____ of the plant was exercised automatically.

b) Finish the statements.

1. Pump is a machine for _____. 2. Compressor is a machine for _____. 3. Centrifugal compressor is a machine for _____. 4. Machine tool is a machine for _____.

11. Read the advertising text and prepare your own one.

PERISTALTIC PUMP. OPERATING PRINCIPLE

The operating principle of a peristaltic pump (fig. 31) attracts by its simplicity and advantages.

A tubular element with accurate dimensions, made in different types of elastomer or thermoplastic, is housed into the pump body.

When this tubular element is compressed by the rotary action of the rotor and its corresponding rollers or shoes, it recovers its initial shape creating a vacuum, suctioning this way the fluid.

The fluid gets into the cavity formed by the rollers that press the tube, and is gently pushed to the outlet by the following roller. Therefore, the pump is a positive displacement volumetric pump with exceptional features.

MAIN CHARACTERISTICS

- Suction lift to 9 meters
- Can run dry without damage
- Sealless
- Reversible rotation
- Resistant to abrasion
- Dosing application $\pm 7 \%$
- Easy and economical maintenance
- Resistance to corrosion
- Silent
- Easy to clean

12. Translate the text into English.

Гідравлика (від грецьких слів *гідро* — вода та *симос* — трубка, струмінь) — наука про закони руху і рівноваги рідини, а також про застосування їх для розв'язування практичних задач (прикладна або технічна *Гідромеханіка*). Гідродинаміка (від *гідро* і *динаміка*) — розділ гідромеханіки, в якому вивчають рух рідин і їхню взаємодію з обтічними тілами чи граничними поверхнями.

Насос — машина, якою переміщують рідину або механічну суміш рідини з твердими речовинами. Розрізняють насоси: відцентрові, осьові,

поршневі, роторні та струминні. Принцип дії відцентрових насосів полягає в переміщенні рідини відцентровими силами, що виникають внаслідок обертального руху робочого колеса. В осьових насосах рідина переміщується паралельно осі робочого колеса під тиском його лопаток. Поршневі насоси переміщують рідину в процесі зворотньопоступального руху *поршня*, при якому вона спочатку засмоктується у робочу камеру, а потім виштовхується у напірний патрубок. В роторних насосах рідину засмоктує і витискає обертовий робочий орган (напр., ексцентрично закріплений барабан, шестерні, гвинт). Дія струминних насосів (напр., *гідроелеваторів, ежекторів, інжекторів*) ґрунтується на прискоренні, яке створює струмина допоміжної рідини, пари або газу. Струминними є також магнітогідродинамічні насоси. Такими насосами переміщують електропровідні рідини (напр., розплавлені метали), використовуючи енергію рухомого магнітного поля. Газоподібні рідини та гази переміщують звичайно *компресорами*. Продуктивність відцентрових насосів — 200 — 50 000 м³/год., осьових — 100 — 100 000, поршневих — до 200, роторних — 0,5 — 100, струминних — 0,1 — 100 м³/год. Насоси застосовують у нафтопереробній і гірничій промисловості, системах водопостачання та каналізації, в гідроприводах верстатів, літальних апаратів, промислових роботів тощо.

13. Consider the mathematical notions and tell what you know on the topic.

Maxima and Minima

A minimum value of a function is not necessarily least value which it assumes. In cases for which a least value actually exists, it has already been called the “lower bound” of the function. We say, for example, that, the function

$$f(x) = x^2 \cos x$$

has a minimum at $x = 0$, since $f(0) = 0$ and $f(x) > 0$ for the values round about 0; but this function oscillates infinitely and has no lower bound.

A precise definition can be formulated in the following way:

Definition: The set of numbers x such that $0 < |x - a| < \eta$ (i.e. the interval $(a - \eta, a + \eta)$ with the number a excluded) is called the neighbourhood of a .

Text 2

1. Read and discuss the text.

Hydromechanic Processes and Apparatuses. Industrial Centrifuge

Centrifuges are used industrially to cast metal pipe, to recover crystalline precipitates such as table sugar, to separate cream from milk or small pieces of lean meat from particles of fat, to concentrate slurries, and to dry laundry.

Working principle. According to Newton's first law, a moving object continues in a straight line unless a force is exerted to deflect it. When an object is moved in a circular path, the reaction against the deflecting force (the pull of the rope on the bucket) is the centrifugal force (which also holds the water in the bucket). The centrifugal force exerted on a particle in a centrifuge is given by:

$F = 0.00001117 (\text{rpm})^2 \times R \times M$ where the force (F) is expressed in grains, the speed (rpm) is in revolutions per minute, the radius R (distance between the axis of rotation and the particle) is in centimeters, and the particle mass (M) is given in grams. Note that the force is directly proportional to the radius (which means that at a fixed speed if the radius is doubled or halved, the force is correspondingly doubled or halved) and is proportional to the square of the speed (doubling the speed increases the centrifugal force at a given radius by a factor of four). For highspeed centrifuges the diameter is limited by the strength of the alloys used. As the speed is increased, the diameter must be decreased, and to a close approximation the maximum speed is inversely proportional to the diameter. The fact that centrifugal force is proportional to the

square of the speed allows very high gravitational fields to be reached in small diameter rotors.

Preparative Laboratory Centrifuges are used in research and in clinical studies, to separate particles ranging in size from blood cells and flocculant precipitates to protein molecules or low molecular weight substances on the basis of either sedimentation rate or buoyant density. *Zonal Centrifugation*. This technique, also termed *isogenic centrifugation*, is widely used to separate subcellular particles, viruses, and DNA molecules. *Swinging-bucket centrifuges* are frequently used for separating large particles, widely used for blood fractionation and for the sedimentation of coarse precipitates. In *the filter-drum centrifuge*, liquid passes through the perforations, while solid particles remain in the drum.

Analytical Ultracentrifuge are optical centrifuges cell fitted with transparent quartz or sapphire windows and scanning photo-multiplier cell for precise measurements and recording the rate of sedimentation, sedimentation equilibrium, and buoyant density.

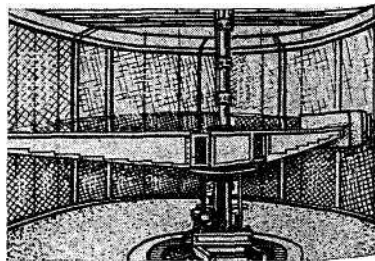


Fig. 32. Centrifuge.

2. Answer the following questions.

1. Where are centrifuges used industrially? 2. What law explains the working principle of a centrifuge? 3. How is centrifugal force expressed and what does it depend on? 4. What kinds of centrifuges are available? 5. What operations are they used for?

3. Fill in the blanks with prepositions.

Separatory-vessel Types. ____ coarse dense-media work three basic

types are most commonly applied. They include (1) modified-spiral-classifier-type vessel, (2) revolving-drum-type vessel, and (3) drag-tank-type vessel. The classifier- and drum-type vessels have been used extensively _____treating iron ores. The drag-tank type is used _____coal treatment. Each _____these types has individual advantages and manufacturers should be consulted in recommendations _____ specific problems _____ selection of the most suitable vessel. Other types of vessels are available and are equally applicable _____ separations handled _____the equipment illustrated.

4. Translate the following texts into English.

Центрифуги

Центрифуга (від лат. *centrum* — осереддя, центр і *fuga* — втеча) — 1) Апарат (установка)для *центрифугування*. Основною частиною центрифуги є *ротор*, що швидко обертається навколо своєї осі, створюючи поле *відцентрових сил*, під дією яких відбувається розділення неоднорідних сумішей (суспензій, шламів, емульсій) з метою виділення твердої або освітленої фаз. Розрізняють центрифуги: осаджувальні (відстійні), фільтрувальніі сепарувальні (або подільні); періодичної і безперервної дії. Центрифуги застосовують у хімічній, харчовій, гірничій промисловості, будівництві, медицині, біології тощо. Для дослідження високомо-лекулярних сполук (білків, нуклеїнових кислот) використовують ультрацентрифугування.

Принципову схему барабана осаджувальної центрифуги — апарата для розділення суспензій і емульсій за допомогою відцентрової сили — показано на рис. 33. Суспензія 1, яка потрапляє в барабан 5, що обертається, починає обертатися разом з ним, завдяки чому виникає відцентрова сила C . Ця сила діє на кожний елементарний об'єм рідини. В центрифугах ця сила перевищує силу тяжіння O в сотні, а іноді в тисячі разів. Через те що поверхня рідини перпендикулярна до напрямку

рівнодійно| сили, яка діє на її елементи, вона з центрифугу розміщується практично паралельно осі обертання, незалежно від положення цієї осі у просторі та від нахилу твірних барабана до його осі.

Поверхнею осадження твердих частинок у центрифугах є внутрішня поверхня суцільних стінок барабана 5. Осад 4 з більшою густиною частинок накопичується на його внутрішній поверхні, а освітлена рідина 2 з меншою густиною розміщується кільцевим шаром ближче до вертикальної осі барабана. На торці барабана

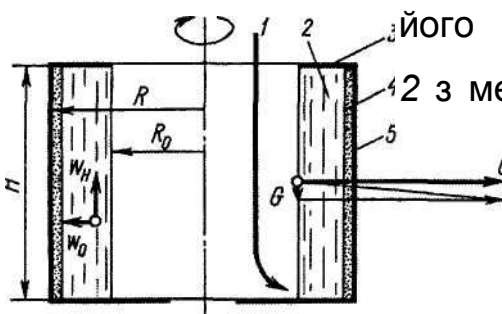


Fig. 33.

є обмежувальне кільце 3, ширина якого визначає масимальну товщину шару суспензії, що може вміщатися в барабані. Оскільки вплив сили тяжіння в барабані, що обертається, незначний, барабан можна обертати навколо горизонтальної осі. Це зручно для механізації та автоматизації вивантаження осаду з центрифуги.

6. Discuss the following topics using the Conditional Mood as well as the introductory and connective words,

1. Kinds of centrifuges. 2. Working principles and applications. 3. Their advantages and disadvantages.

Use the words of argument to develop and prove your idea.

I move that, because, according to, considering, taking into consideration that, provided, suppose, assuming the fact that, based on, on the ground that, there is no doubt that, it is quite evident that, support the statement with, illustrate the fact (phenomenon, theory), challenge, argue that, object, agree, exactly so, argue the statement, disagree, in view of these advantages, In contrast to this., It is essential / particularly valuable / desirable / is necessary , it goes without saying.

Unit 12

1. Learn the notions and their definitions.

Conduction the transfer of heat by molecular action.

Convection turbulent transfer, the transfer of heat by a mixing process.

Radiation the transfer of heat by emission and absorption of energy without physical contact.

Heat-transfer coefficient a method of calculating film coefficient.

Steam The invisible vapor into which water is changed when it is heated to the boiling point.

Boiler A vessel in which water is boiled to produce steam.

Condense To return to a liquid state, as when steam reverts to water. The process is *condensation* and a device that causes the process to take place is a *condenser*.

Vacuum A space devoid of matter. Vacuums are *partial*, not complete.

Valve A device that opens or closes to control the flow of liquids or gases.

Evaporation the operation of concentrating a solution by boiling away the solvent.

Text 1

1. Read, translate and retell the text.

Industrial Heat-Exchange Equipment

Heat-Exchangers. Principles of Unit Operations

Two mechanisms of heat transfer have already been established:

Molecular — the transfer of heat by molecular action; this is referred to as conduction. *Turbulent* — the transfer of heat by a mixing process; this is usually referred to as convection. It has been established that these two mechanisms can occur simultaneously or individually.

A third mechanism of heat transfer which is common but which has not

yet been discussed is *radiation*, which is the transfer of heat by emission and absorption of energy without physical contact. Unlike conduction or convection, which depend upon physical contact for thermal-energy transfer, radiation depends upon electromagnetic waves as a means for transferring thermal energy from a hot source to a low-temperature sink. Radiation may occur simultaneously with, or independent of, the other two mechanisms of transfer.

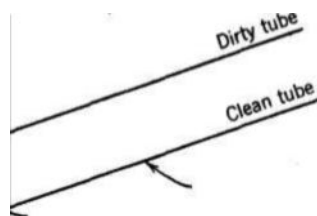
The one characteristic common to most heat exchangers is the transfer of heat from a hot phase to a cold phase with the two phases being separated by a solid boundary.

Heat-Transfer Coefficients. A method of calculating film coefficients was proposed by Wilson for condensing vapors. It is based on the over-all resistance ($1 / UA$) being equal to the sum of the individual resistances,

$$\Sigma R + 1/UA = R_c + R_w + R_d = R_L$$

where R_c = condensate resistance R_w = wall resistance R_d = scale or dirt resistance R_L = liquid-side resistance

The vapor-side resistance depends upon the temperature driving force and upon the temperature of the condensate. The dirt resistance and tube-wall resistance also depend upon their respective temperatures.



$$\text{Slope} = 1/C_2$$

Double-Pipe Heat Exchangers. The simplest type of heat exchanger is the double-pipe heat exchanger as the basis for others. The double-pipe heat exchanger is essentially two concentric pipes with one fluid flowing through the center pipe while the other fluid moves cocurrently or countercurrently in the annular space. The length of each section is usually limited to standard

pipe lengths, so that, if an appreciable heat-transfer surface is required, banks of sections are frequently used. If the required area is too large, a double-pipe exchanger is not recommended. The use of a double-pipe heat exchanger is not limited to liquid-liquid heat exchange but may also be used for gas-liquid exchange and for gas-to-gas exchange. Materials of construction may vary, depending upon the fluids being handled. Either fluid may be moved through the tube or annulus at relatively high velocities, thereby aiding in the heat-transfer process.

Shell-and-Tube Exchangers. When the required heat-transfer surface is large, the recommended type of exchanger is the shell-and-tube variety. In this type of heater or cooler, large heat-transfer surface can be achieved economically and practically by placing tubes in a bundle; the ends of the tubes are mounted in a tube sheet. This is very commonly accomplished by expanding the end of the tube into a close-fitting hole in the tube sheet by a process called "rolling." The resultant tube bundle is then enclosed by a cylindrical casing (the shell), through which the second fluid flows around and through the tube handle.

Vocabulary

heat transfer	перенос тепла
solid boundary	надійний кордон
vapour, steam	пара
absorb	всотувати
waves	хвилі
sink	желоб
heat exchanger	теплообмінник
shell, casing	кожух
handle liquid	працювати з рідиною
bundle	пучок
tube handle	важіль труби
annulus	кільце, зазор, зубчасте колесо

	із внутрішнім зачепленням
tube / pipe sheet	полотно труби

2. State whether the following statements are true or false and comment on them using the introductory and connective words.

1. Only two mechanisms of heat transfer have already been established.
2. The transfer of heat by a mixing process is usually referred to as conduction.
3. Radiation is the transfer of heat by emission and absorption of energy without physical contact. 4. Radiation may occur independently of the other two mechanisms of heat transfer. 5. The vapor-side resistance depends upon the temperature. 6. Materials of construction may vary, depending upon the fluids velocity. 7. Large heat-transfer surface can be achieved in double-pipe heat exchanger.

3. Translate and answer the following questions.

1. Які три види переносу тепла існують? 2. Чим радіація відрізняється від конвекції та конвенції? 3. Що спільне мають між собою всі теплообмінники? 4. Що відображує коефіцієнт переносу тепла? 5. Які бувають види теплообмінників?

4. Find in the text the equivalents of the Ukrainian words and expressions:

електромагнітні хвилі, залежати від, джерело тепла, коефіцієнт переносу тепла, вираховувати коефіцієнт плівки, був запропонований, конструкція може бути різною, конденсаційна пара, заснований на, дорівнює сумі, опір конденсату, ведуча сила, відповідна температура, рідина рухається через, довжина, разом з потоком, відносно висока швидкість, нагрівач, охолоджувач, на низькій швидкості, розподіляється в трубах, паралельним потоком, витікає з труб, покидає пристрій, кожух.

5. Fill in the gaps.

emission, countercurrently, common, pipes, resistance, wave, cocurrently, exchanger, vapor, establish, simultaneously, transfer.

Two mechanisms of heat ____ have already been established: It has been ____ that convection and conduction can occur simultaneously or individually. *Radiation* occurs by ____ and absorption of energy without physical contact. Radiation depends upon electromagnetic ____ as a means for transferring thermal energy from a hot source to a low-temperature sink. Radiation may occur ____ with, or independent of, the other two mechanisms of transfer. The one characteristic ____ to most heat exchangers is the transfer of heat from a hot phase to a cold phase with the two phases being separated by a solid boundary. A method of calculating film coefficients was proposed by Wilson for condensing _____. It is based on the overall _____. The double-pipe heat ____ is essentially two concentric _____. One fluid flowing through the center pipe while the other fluid moves ____ or ____ in the annular space.

6. Match the notions and their definitions.

1) conduction, convection, heat-transfer coefficient, evaporation, radiation.

2) the operation of concentrating a solution by boiling away the solvent; the transfer of heat by a mixing process; the transfer of heat by molecular action; the transfer of heat by emission and absorption of energy without physical contact; a method of calculating film coefficient.

7. Define the words with the same root and use them in situations.

exchange – exchanger, solvent – solution – dissolve – solubility – soluble, vapour – evaporate – evaporation – evaporator.

8. Group the synonyms.

tube, raise, thermal energy transfer, heat transfer, place, casing, enclose, device, unit, decrease, annulus, transmission, radiation, drop,

emission, solute, mix, tank, transmission, abrasive, shell, vessel, fall, suspension, agitate, damaging, increase.

9. Transform the sentences using the Conditional Mood.

1. An appreciable heat-transfer surface is required, so banks of sections are frequently used. 2. The required area is too large, so a double-pipe exchanger is not recommended. 3. The centrifugal pumps have the disadvantages that their output is effected by changes in pressure on the delivery side and they are not suitable for viscous liquids. 4. Because of its positive-displacement characteristic, reciprocating pump is sometimes used for metering fluids. 5. Liquids containing abrasive solids should not be pumped with a reciprocating pump because of damage to the machined surfaces. 6. Liquid enters the cylinder through a check valve which is opened by an external pressure acting on the fluid. 7. The flow of the fluid through the inlet valves follows the piston movement backward through the cylinder on its inlet stroke. 8. When the piston moves forward, the inlet valve closes, and a second valve is forced open to discharge the liquid. 9. The piston must have a close fit with the cylinder walls in order to minimize liquid slip past the piston. 10. If the piston carries with it its own packing, it is called a piston pump.

10. Complete the following sentences paying attention to the Absolute Nominal Participle Construction:

1. The conditions being favourable, the engineers ____; 2. the speed being constant, the experiment ____; 3. The equilibrium conditions having been provided, the substance ____; 4. The possible decision having been discussed, the meeting ____; 5. The measurement being introduced, this equation ____; 6. The student having obtained these results, the experiment ____; 7. The body ____, the force being removed ____; 8. The solid bodies ____, the limit of elasticity being exceeded.

11. Translate the following text into English.

Теплообмінні апарати

За способом передавання теплоти усі теплообмінники поділяють на дві великі групи: поверхневі і змішувальні. В *поверхневих* теплообмінниках обидва теплоносії відокремлені один від одного твердою стінкою або по черзі контактують з однією і тією самою стінкою, яка бере участь у процесі теплообміну й утворює так звану поверхню теплообміну. Залежно від призначення теплообмінного апарата цю поверхню також часто називають поверхнею нагріву або охолодження. У *змішувальних* теплообмінниках, або апаратах змішування, теплообмін здійснюється внаслідок безпосереднього контакту і змішування гарячого й холодного теплоносіїв.

Поверхневі теплообмінники, у свою чергу, поділяють на рекуперативні і регенеративні. В рекуперативних апаратах один бік поверхні теплообміну весь час омиває гарячий теплоносій, а другий — холодний. Теплота від одного теплоносія до другого передається крізь стінку з теплопровідного матеріалу, що їх розділяє. Напрямок теплового потоку в стінці лишається незмінним. У регенеративних апаратах одна й та сама поверхня теплообміну поперемінно омивається то одним, то другим теплоносієм. У період нагрівання, тобто під час контакту з гарячим теплоносієм, у твердих тілах (насадці), що заповнюють апарат, акумулюється теплота, яка в період охолодження віддається рухомому холодному теплоносію. Напрямок потоку теплоти в стінках періодично змінюється.

У харчовій промисловості для нагрівання й охолодження використовують переважно рекуперативні теплообмінники.

12. Discuss the topics using the Conditional Mood as well as the introductory and connective words.

1. Mechanisms of heat transfer. 2. Heat transfer coefficient. 3. Kinds and applications of heat exchangers.

referred to as, common, as a means of / for, a method of, is based on, unlike, is essentially, depends on, appreciable, is used, required, thereby aiding, to achieve.

13. Consider the mathematical notion and tell what you know on the topic.

Power Expansions (Historical Introduction)

The powers of a variable x appeared originally purely in algebraic problems. With the development of calculus the great importance of power expansions became evident. The expansion discovered by Taylor (1715) and by Maclaurin (1742) enables us to predict the course of a function if we know the value of the function and its derivatives in one particular point. The "Taylor series" thus became one of the cornerstones of analytical research and was particularly useful in establishing the existence of solutions of differential equations. The Taylor expansion may converge in the entire complex plane or within a given circle only, and it may diverge even at every point.

Text 2

1. Read the text, prepare its essay.

Evaporators

Evaporator Construction. Principles of Unit Operation. Evaporation is the operation of concentrating a solution by boiling away the solvent. The concentration is normally stopped before the solute begins to precipitate from solution. Basically, then, an evaporator must consist of a heat exchanger capable of boiling the solution and a device to separate the vapor phase from the boiling liquid. In its most simple form it might be a pan of

liquid sitting on a hot plate. The surface of the hot plate is a simple heat exchanger, and vapor disengaging is obtained by the large area for vapor flow and its consequent slow rate of flow. In industrial operation the equipment is usually arranged for continuous operation; the heat-exchange surface is vastly increased; boiling is much more violent, and vapor evolution is rapid. Such problems as foaming, scaling, heat sensitivity, corrosion, and space limitations are met. These problems have resulted in variations and refinements in evaporator design to meet different combinations of solution properties and economic conditions.

Evaporator-body construction falls into a few general categories. The *horizontal-tube evaporator* is one of the classic construction types and has been widely used for many years. The solution to be evaporated boils outside of horizontal tubes within which steam condenses. Solution boils inside vertical tubes with the heating medium, usually condensing steam, held in a chest through which the tubes pass. In *the basket evaporator*, the steam chest forms a basket hung in the center of the evaporator. Boiling or heating of the liquid in the tubes causes flow upward through the tubes, and unevaporated liquid flows downward through the annulus around the basket. The tubes are inserted into tube sheets by rolling or welding.

Vocabulary

unit	прибор, блок,
precipitate,	
sediment	осад
solute	розчин
solvent	розчинник
solubility	розчинність
supersaturation	перенасиченість
rate of flow	швидкість потоку
foam	піна

scale	рівень, шкала
sensitivity	чутливість
refinement	очищення
evolution, discharge	вихід, випуск
basket evaporator	камерний випарник

2. Complete the sentences.

1. Evaporation is the operation of ____ 2. Basically, an evaporator must consist of ____ 3. The surface of the hot plate is ____ 4. In industrial operation the equipment is usually ____ 5. Such problems as ____ 6. These problems have resulted in ____ 7. Evaporator-body construction ____ 8. The *horizontal-tube evaporator* is ____ 9. The solution to be evaporated boils outside of horizontal tubes within which steam condenses. 10. In *the basket evaporator*, the steam chest forms a basket hung in the center of the evaporator.

3. Translate the questions into English and answer them.

1. Що являє собою випарювання? 2. За яких умов має місце випарювання? 3. З яких частин складається випарник? 4. Які проблеми виникають у промисловому вживанні випарників? 5. Які види випарників застосовуються у виробництві?

4. Translate the following text into English.

Випарні апарати

У харчовій промисловості набули поширення різноманітні випарні апарати. Випарні апарати можна класифікувати за методами обігрівання, компонуванням і конструкцією поверхні нагріву, за розміщенням робочих середовищ, режимом роботи, кратністю циркуляції розчину і т. ін.

У харчовій промисловості випарні апарати обігріваються здебільшого водяною парою. Парове обігрівання відрізняється гнучкістю

регулювання, високими коефіцієнтами теплопередачі, а водяна пара — високою енергоємністю. В малих випарних апаратах і лабораторних установках практикують електрообігрівання. Трубчаста поверхня теплообміну може бути: вертикальною, горизонтальною і, рідко, нахиленою; із вбудованою нагрівальною камерою і з винесеною. За розміщенням робочих середовищ випарні апарати поділяють на апарати з подаванням нагрівної пари в труби (кипіння розчину у великому об'ємі) і з подаванням пари в міжтрубний простір (кипіння розчину в трубах). За режимом руху киплячої рідини випарні апарати бувають з природною і вимушеною, з одноразовою і багаторазовою циркуляцією рідини, плівкові.

Кожний випарний апарат складається з двох основних елементів: нагрівальної камери — теплообмінника, що забезпечує передачу теплоти від теплоносія до випарюваного розчину крізь поверхню теплопередачі, і паро-сепаратора — парового (надсокового) простору, в якому вторинна пара відділяється від киплячого розчину.

Найпоширенішими є випарні апарати з вертикальними трубчастими нагрівальними камерами. Вони відносно компактні, у них забезпечуються сприятливі умови теплопередачі. В апаратах цього типу випарюваний розчин міститься в трубах, а нагрівна пара — в міжтрубному просторі, що дає змогу порівняно легко видаляти відклади (накип) з поверхні труб.

5. Discuss the topics.

1. The main principles underlying evaporators operation.
2. Evaporator construction.

Text 3

1. Read the text for information.

Mass-Exchange Processes and Apparatuses. Crystallizers

Crystallizing apparatus or vacuum pan is essentially a simple vacuum evaporator in which the removal of water continues until the concentration is appropriate for crystallization. A vacuum pan is a large cylindrical metal vessel. It is strong enough to resist collapse when the vacuum is high. The heating surface of the pan is a calandria which is a drum with tubes or multicorps heat-exchanger heated with water vapour to t° higher than the boiling juice. Then the juice is thickening under pressure. The sugar liquor is boiling and thickening in the pan, and when it is ready for graining some sugar dust is added.

Crystallizers may also be classified in the following manners: batch vs. continuous, agitated or non-agitated, classifying or non-classifying. Classifying crystallizers function in such a manner that crystals are retained in the crystallizer until they have reached a minimum size before discharge.

To force crystallization, it is necessary to maintain the crystallizing solution in a supersaturated condition. Choice of equipment usually depends on the solubility-temperature relation of the substance to be crystallized. For solutes with a small positive temperature coefficient of solubility, or a negative coefficient, supersaturation must be developed by evaporation. If the solute has a large positive temperature coefficient, cooling without evaporation can produce the required supersaturation.

Crystallization can also be induced by adding a second solvent to reduce the solubility. This method has not found extensive application.

Tank Crystallization. Common practice in producing crystals has been to prepare hot, nearly saturated solutions and to cool them, by natural convection, in open tanks. Sometimes rods or strings are hung in the tanks to give the crystals additional surface on which to grow and to keep at least a part

of the product out of the sediment that might collect in the bottom.

Vocabulary

batch	перервної дії
continuous	перервної дії
agitate	перемішувати
maintain	підтримувати
discharge	вивантажувати
reduce solubility	зменшувати розчинність
rod	стрижень
string	пружина

2. Complete the sentences.

1. *Crystallizers* may also be classified _____. 2. To force crystallization, it is necessary _____. 3. Choice of equipment usually depends on _____. 4. Crystallization can also be induced by _____. 5. It might be _____.

3. Translate the text into English.

Кристалізатори

Апарати для кристалізації в харчовій промисловості можна класифікувати за такими критеріями: просторове розміщення — вертикальні, горизонтальні, похилі; конструкція корпусу — циліндричні, коритні; кількість секцій — одnoseкційні, багатосекційні; характер руху суспензії, що кристалізується, — циркуляційні, прямотечійні, прямотечійно-циркуляційні, з природною та штучною циркуляцією; конструкція поверхні теплообміну — з трубчастими, кільцевими, дисковими, змієвиковими, пластинчастими поверхнями теплообміну, з рухомими і нерухомими поверхнями теплообміну.

Різноманітність конструкцій апаратів для кристалізації зумовлена прагненням задовольнити критерій відповідності конструкції вимогам технології, а також критеріям: загальноконструктивних та експлуатаційних

переваг; оптимальних техніко-економічних показників; естетики, ергономіки; екологічних вимог тощо.

Вакуум-апарати періодичної дії. Прикладами таких апаратів для отримання утфелів у цукровій промисловості можуть бути вакуум-апарати типу А2-ПВР. Це апарат періодичної дії з підсиленою циркуляцією утфелю за допомогою механічного циркулятора. Апарат має корпус з нижнім конічним дном та кришкою. У верхній частині розміщено сепаратор, парову камеру — у нижній частині корпусу. До дна прикріплено пристрій для вивантаження утфелю з апарата та кільцевий колектор для рівномірного подавання продукту в апарат. У верхній частині апарата є затвор, крізь який відводиться вторинна пара.

Всередині апарата змонтовано механічний циркулятор, що складається із лопатевого перемішувача, закріпленого на валу. Вал обертається в підшипниках ковзання і за допомогою муфти з'єднується з валом приводу. Привід має електродвигун потужністю 22 кВт, клинопасову передачу і циліндричний двоступеневий редуктор. Частота обертання вала циркулятора $8,1\text{с}^{-1}$.

4. Use the derivatives of the verbs: dissolve, crystallize, evaporate, saturate to describe:

1. The stage of sugar crystallization. 2. The arrangement and principle of crystallizer operation.

5. A. Write a virtual essay on food industry equipment according to the plan given.

1. Introduction. 2. Technological part. 3. Automatization of technological processes. 4. Building part. 5. Labour safety. 6. Research work. 7. Conclusion. 8. Appendix (if there is any). 9. Literature used.

B. Prepare a technical project according to the plan given.

1. General drawing. 2. Specification. 3. Explanatory note with calculations, draft drawings and comments of the machine (part) drawing.

METALS

UNIT 13

1. Learn the notions and their definitions.

Metalloid is a material having properties of both metals and nonmetals.

Resistance the ability to resist chemicals.

Strength the ability to withstand heavy weight without bending, breaking.

Tough not easily cut, broken or worn out.

Conductivity property to pass the electric current..

Magnetism property to attract other metals.

Valency combining capacity.

2. Read the text. Find the difference between metals and metalloids.

Translate the text.

Text 1

Metals' Properties

Metals are any substance that conducts electricity and heat well, is shiny (exhibits what is called metallic luster), is opaque, can be made very strong by proper alloying and other techniques, and can be readily formed by rolling, drawing, and cutting. More than 75% of the elements are metals. Metals have crystal structure. An atom in a metal is usually closely surrounded by a large number of other atoms.

Metalloid is a material having properties of both metals and nonmetals. Most metalloids have the physical appearance and luster of metals, yet are brittle and are poor conductors of heat and electricity at room temperatures (as are most nonmetallic materials). Included among the metalloid elements are germanium, silicon, arsenic, antimony, boron, and tellurium. In addition, the rare elements astatine and polonium are sometimes considered metalloids.

Thousands of compounds are metalloids.

Metals do not have to be pure elements. Some compounds, such as tantalum carbide, are also metals. *Alloys* are combinations. For example, copper and zinc, melted together in the proper proportions and solidified, form the alloy brass. Brass is neither a mixture nor a compound but a solution having the same crystal structure as the base metal, copper. Alloying usually decreases electrical conductivity.

Metals have a wide range of densities, varying from one-half gram per cubic centimeter (0.5 g/cm^3) for lithium to 22.5 g/cm^3 for osmium, the densest material known. The melting points of metallic elements vary from -38.0° F (-38.9° C) for mercury to 6170° F (3410° C) for tungsten, while hafnium carbide melts at 8312° F (4600° C).

Metals can be highly reactive (cesium oxidizes and reacts violently with chlorine). They can also be highly resistant to oxidation (gold) or to attack by strong acids (gold, tantalum, stainless steel).

Steel. Carbon steel is the most common as the cheapest and most versatile metal used in industry. It has excellent ductility, permitting many cold-forming operations. Steel is also the most weldable of all commercial metals. It is two-thirds the weight of lead, three times heavier than aluminium. The corrosion resistance of steel depends upon the formation of an oxide surface film. However, resistance to corrosion is somewhat limited. Carbon steel should not be used in contact with dilute acids. Between 90 and 98 per cent, steel can be used up to the boiling point.

Vocabulary

property	властивість
withstand	витримати
bend	гнути
non-ferrous metals	кольорові метали
brass	латунь
rusting	іржавіючий

substance	речовина
conduct	проводити
alloy	сплав
opaque	матовий
draw	тягнути
stiffness	жорсткість, твердість
toughness	міцність, пружність
fracture	тріщина
malleability	ковкість, тягнучість
ductility	пластичність, в'язкість, тягнучість, ковкість
stainless	неіржавіюча, легована
wire	провід
copper	мідь
foil	фольга
solution	рішення, розчин
dispersed nodules	розсіяні вузлики

3. Discuss metals' properties in English.

1. Які властивості мають метали? 2. Що таке міцність металів? 3. Що таке провідність та магнетизація? 4. Де використовуються метали? 5. Для чого застосовуються сталеві конструкції? 6. Як класифікуються метали? 7. Які метали відносять до кольорових? 8. Яке застосування мають метали з високою електропровідністю.

find, property, strength, conduct, resist, toughness, melt, malleability, ductility, conductivity, rust, corrode, withstand weight, non-ferrous metal, alloy, use.

4. Find in the text the equivalents of the Ukrainian words and expressions.

речовина, поліпшувати фізичні властивості, проводити електрику,

блискучий, чистий елемент, легко обробляється, сполука, сплавлений з, різання, стійкий до корозії, високореактивний, окислення, властивість витримувати вагу, іржавий, неіржавіюча / легована сталь, широкий діапазон густини, сплав міді, підвищувати твердість, чавун, кольорові сплави, точка плавлення, сплав заліза, містити залізо, легка вага, невелика кількість.

5. A. Classify the following metals, metalloids, and metals substitutes and discuss their properties with the group.

a) stainless steel, alloys, high alloys, nickel, aluminium, arsenic, boron, tellurium, polonium, copper, brass, bronze, lead, titanium, zirconium, tantalum, glassed steelplastics, germanium, siliconpolyethylene, unplasticized polyvinyl chloride, acrylonitrile butadiene styrene, polymers, chlorinated polyether, acetats, cellulose acetate butyrate, polyester resins, epoxies.

B. Guess the names of metals and alloys.

inro, dogl, teesl, ianumlimu, rpecop, vseilr, mucihrho, rbssa, ldea, rbozne, ckenli.

6. Fill in the blanks.

luster, weldable, decreases, ductility, pure, densities, resistant, form, compounds, brittle, properties, conducts, alloying, drawing, cutting.

Metals are any substance that ____ electricity and heat well, is shiny (exhibits what is called metallic ____), is opaque, can be made very strong by proper ____ and other techniques, and can be readily formed by rolling, ____ and _____. *Metalloid* is a material having ____ of both metals and nonmetals. Most metalloids have the physical appearance and luster of metals, yet are ____ and are poor conductors of heat and electricity at room temperatures (as are most nonmetallic materials). Thousands of ____ are metalloids. Metals do not have to be ____ elements. *Alloys* are

combinations. For example, copper and zinc, ____brass. Alloying usually ____ electrical conductivity. Metals have a widerange of _____. Metals can be highly reactive They can also be highly ____ to oxidation (gold) or to attack by strong acids (gold, tantalum, stainless steel). Carbon steel has excellent _____, permitting many cold-forming operations. Steel is also the most _____ of all commercial metals.

7. a) Match the notions and their definitions.

resistance, strength, conductivity, magnetism, valency, metal.

strength of joining, he ability to resist chemicals, the ability to withstand heavy weight without bending, breaking, property to pass the electric current, property to attract other metals, any shiny substance that conducts electricity and heat well and can be readily formed by rolling, drawing, and cutting.

b) Define the notions.

alloy, ferrous, non-ferrous, ductility, malleability, toughness, melting point, corrosion, cast iron, pearlitic steel.

8. A. Group the synonyms.

metal, quantity, load, plastic, crack, strength, form, steel, differ, substitute, fracture, apply, construct, type, separate, flow.

B. Group the antonyms.

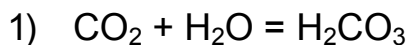
ferrous, conductor, heat, weakness, repair, insulator, shapely, important, breakable, used, strength, result.

9. Define the words with the same root and use them in situations.

react – reaction – reacting – reactor – reactive – reactivity, weld – welder – welding – weldability, oxide – oxidize – oxidizing – oxidation – oxygen, boil – boiler – boiling – boiled, resist – resistance – resistor, malleable – malleability, ductile – ductility, operate – operation – operator, solution – solubility – solution – dissolve – solvent.

10. Read and explain the chemical formulas.

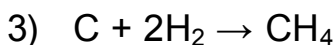
+ plus / and / together with added to / combined with, = give / form
/ are equal to, → forms and is formed from, ← give / pass over to / lead to.



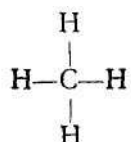
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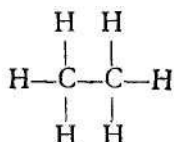
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[si: plʌs tu: 'molikju:lz əv eitʃ tu: qiv si: eitʃ fo:]



[si: eitʃ fə:]



[si: tu: eitʃ sɪks]

11. A. Use the Gerund – V-ing nominal form in sentences to describe: 1) metals manufacturing and processing.

melting, casting, conducting, forming, shaping, alloying, rolling, drawing, cutting.

2) metals finishing.

by means of / by way of / by method of chemical surface finishing, metallic coating, spraying, hot-dipcoating, plating (покрытия металом) gas plating, vapour deposited coating, composite low-friction coating, chemical displacement (заміщення) coating, electroplating, conversion coating.

B. Replace the infinitives or noun-groups with the gerunds.

Model. The experiment needs to be repeated. The experiment needs repeating.

1. There are different ways to solve this problem. 2. It is worth while to remember this rule. 3. Excuse me to have arrived late. 4. We insisted to be informed about it. 4. Iron needs treatment. 5. It is no use / good / sense to test this alloy. 6. The corrosion resistance of steel depends upon the formation

of an oxide surface film.

12. Translate the following text into English.

Жароміцні сталі та сплави

Серед сучасних жароміцних матеріалів основне місце займають сталі – матеріали відносно дешеві, з добрими технологічними властивостями. За масштабами застосування їм належить провідне місце в умовах роботи за температур 450...750 °С. За температур нижче 450 °С можливо і доцільно використовувати вуглецеві конструкційні сталі.

Можливості підвищення жароміцності заліза легуванням обмежені малою розчинністю в ньому легуючих елементів. Тому сталі перлітного і мартенситного класів мають невисоку жароміцність і придатні для роботи за температури 450... 600 °С.

Основними компонентами в сталях *перлітного класу* є карбідоутворювальні елементи: Cr, Mo, Nb, Al, V, вміст яких, за винятком хрому, становить близько 1 %. Основою таких сталей є малолегований твердий розчин – ферит з включеннями зміцнювальних фаз – карбідів: Fe₃C, Mo₂C, VC тощо. Найефективнішим серед них є карбід ванадію VC.

Перлітні сталі пластичні, добре обробляються різанням і зварюються, в діапазоні робочих температур відзначаються високою стабільністю структури. Вони належать до числа кращих матеріалів, здатних до роботи в умовах тривалого навантаження за вказаних температур. Використовуються на потужних ТЕС для виготовлення листових і трубчастих конструкцій, відзначаються підвищеною жароміцністю в інтервалі 400...550 °С.

Мартенситні сталі відрізняються від перлітних більшим вмістом хрому (5 - 8 %) і тому більшою жаростійкістю в атмосфері

водяної пари, продуктів згоряння тощо.

Для забезпечення високих і стабільних властивостей у процесі експлуатації ці сталі додатково легують Mo, Al, V.

Мартенситні сталі застосовують для експлуатації за температури 500...600 °C у термообробленому стані – після гартування або нормалізації та високого відпуску.

До теплостійких можна також віднести деякі сталі аустенітного класу, для яких максимальна робоча температура за тривалої експлуатації становить 600 °C. Ці сталі належать до високолегованих типу 18/9, відзначаються значним вмістом хрому і нікелю з додатковим легуванням. При малому вмісті вуглецю і гомогенній структурі вони мають високі пластичні властивості, тому застосовуються для виготовлення деталей тиском (куванням, штампуванням), а також для зварних листових і трубчастих конструкцій.

Text 2

1. Read the text below, entitle it, decipher the abbreviations and speak about D. Mendeleev and his periodical table.

Valency stands for "strength of joining" (combining capacity) that divides the elements into classes; the reason for the varying weights of the same element in different compounds.

Sometimes more than one set of atoms go to make up a molecule, e. g. methane: hydrogen is valency 1, carbon is valency 4, so the formula must be CH₄; four atoms of H to one of C. And the recipe will be:

Hydrogen	Carbon	CH ₄ Methane
(at. wt. 4x1)	+ (at. wt. 12x1)	→
4 parts by weight	12 parts by weight	16 parts by weight

The molecular weight of hydrogen fluoride is 40, yet the atomic

weight of hydrogen is 1 and of fluorine 19, so HF would equal 20. This means the formula must be written $(\text{HF})_2$ or H_2F_2 — there are two sets of atoms in the molecule.

2. Fill in the gaps with the introductory and connective words and exemplify the information.

Today plastics are referred _____ materials of great importance, for no other group of materials is able to offer _____ a unique combination _____ properties. By alloying, modifying _____ well as _____ changing the structure of polymers, chemists and technologists are able to produce different kinds of plastics. Plastics can be mass produced _____ a lower cost compared with metal parts. _____ plastics do not possess the high strength of steel they are suitable _____ many purposes. Plastics can be reinforced _____ incorporating fibrous materials such _____ glass fiber, nylon and, at last, pure carbon fibers. The carbon plastics are known to open up vast new possibilities _____ the engineering field. Some plastics are able to withstand much higher temperature than metals. There exist plastics _____ have high mechanical strength and are able to withstand the extremes of pressures. It gives them a great advantage _____ metals.

3. Arrange a scientific conference on the following topics. Use the gerunds, as well as the introductory and connective words.

1. The composition and properties of metals. 2. Alloys and metalloids.
3. Metals application. 4. Metals substitutes.

Text 3

1. Scan the text for metal-forming operations. Read and translate the text.

Metal Forming

The formability of metal is based on atomic structure. In each

crystal or grain of the metal are slip planes that allow relative movement. As slip is induced by outside forces, the metal will yield because of the sliding action. Forming can be divided into forging, pressing and bending, drawing, extruding, casting, powder metallurgy, and spinning.

Shearing. Shearing produces separation in the metal by localized forces applied in opposite directions that are beyond the tensile strength of the material. One of the most common shearing operations is done by stamping dies.

Pressing. Pressing usually refers to the press-working of metals between dies in a press. The most common method is that of forming metal between matched dies. The part may first be blanked out and then formed, or the part may be formed from a larger sheet and then cut to exact size by the use of trimming dies. *Embossing* is a process of deforming metal between matched dies without changing its thickness. Common examples of this process are decorative brass or copper plates and medallions. *Coining* is a pressworking process in which the thickness of the metal is changed. The most common example of this process is in the production of coins. The metal must be made to flow into the die to produce different designs on each side of the metal. High unit forces are required, three to five times the compressive strength of the metal.

Forging. Forging is the localized plastic working of metal by means of compressive forces applied by manual or power hammers, presses, or special forging machines. The process may be done hot or cold; however, the hot process is implied because cold forging has other names such as *cold heading* or *upsetting*. Forging produces very strong products.

Extrusion. Metal is extruded by placing it in a chamber and forcing it through a die. This method is used in making long bars of many

familiar shapes such as tubes, aluminium door and window frames.

Vocabulary

grain	зерно
slip planes	площина ковзання
shearing	розривання
stamping die	штамп для тиснення
blank out	розкривати
sheet trimming	обрізка листа сталі
embossing	тиснення
coining	чеканка
compound	сполука, суміш, з'єднання
thickness	товщина
density	густина
turbulent pool	відстойник, сварочний резервуар
melt	плавити(ся)
electron-beam welding	електозварка
volume	об'єм
refractory metals	вогнестійкий, тугоплавкий
frequency	частота
tensile strength	кордон міцності на розрив

2. Translate the following text into English.

Основні види обробки металів тиском

Обробка металів тиском ґрунтується на використанні однієї з основних властивостей металів — пластичності. Вона проявляється в незворотній зміні форми та розмірів тіла під дією зовнішніх сил без порушення його цілісності, яка супроводжується зміною структури та механічних властивостей металу.

До основних видів обробки металів тиском належать прокатування, пресування, волочіння, кування, об'ємне і листове штампування.

Прокатуванням називають обтискання металу обертовими валками (рис. 34, а). За його допомогою отримують вироби з однаковою по довжині формою поперечного перерізу (прутки, дрід, рейки, листи, труби) або з формою, що періодично змінюється по довжині.

Пресування полягає у витисканні нагрітого металу із замкненої порожнини крізь отвір у матриці (рис. 34, б). Форма та розміри поперечного перерізу пресованих виробів відповідають конфігурації та розмірам цього отвору.

Волочіння — це протягування заготовки крізь отвір у волочильній матриці-волоці (рис. 34, в). Волочінням отримують тонкі сорти дроту, калібровані прутки, тонкостінні труби.

Кування — процес деформування нагрітої заготовки між бойками молота або преса (рис. 34, г). Зміна форми та розмірів заготовки досягається послідовно дією бойків чи інструменту на різні ділянки заготовки. *Об'ємне штампування* полягає в одночасному деформуванні всієї заготовки в спеціальному інструменті — штампі на .

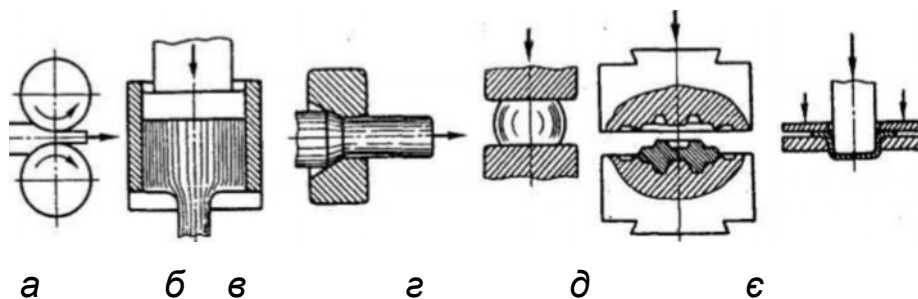


Рис. 34. Схеми основних видів обробки металів тиском молотом, пресах або горизонтально-кувальних машинах (рис. 34, д). Форма та розміри внутрішньої порожнини штампа визначають конфігурацію і розміри поковок.

Листове штампування призначене для виготовлення плоских та об'ємних порожнистих деталей з листа або стрічки за допомогою штампів на холодноштампувальних пресах (рис. 34, є).

3. Discuss with your group the methods of metal forming. Use gerunds, as well as the introductory and connective words.

4. Consider the mathematical notion and tell what you know on the topic.

Continuity

A continuous function may be described roughly as one whose graph contains no sudden jumps, so that it may be drawn without lifting the pencil from the paper. Thus a function is continuous at $x = c$ if, when x is just greater than or just less than c , its values are nearly equal to $f(c)$.

Definition: If $\lim_{x \rightarrow c+0} f(x)$ and $\lim_{x \rightarrow c-0} f(x)$ both exist and

$$\lim_{x \rightarrow c+0} f(x) = \lim_{x \rightarrow c-0} f(x) = f(c)$$

equal $f(c)$, $f(x)$ is continuous at $x = c$. Otherwise $f(x)$ is discontinuous at $x = c$.

5. Write and retell an abstract of some interesting publication according to the plan.

1) The title, 2) The name of the author, 3) The name of the journal, its number, year, place of edition, volume, number of pages, figures, tables, 4) A range of problems covered / considered, 5) Characteristics and evaluation of the publication (facts laid out, problems raised, grounding, conclusions, prospects).

METAL PROCESSING EQUIPMENT

UNIT 14

Text 1

1. Read, translate and retell the text.

Machine Tool

Machine tool is any of a wide variety of tools, usually large, rugged, and power driven, for cutting, shaping, or forming metal. Precision of operation makes it possible to produce hundreds of identical parts, all so much alike that they may be freely interchanged or substituted in assembly or repair, without hand-fitting.

Machine- tools are known to serve four main purposes: 1) they hold the work or part to be cut; 2) they hold the cutting tool (or tools); 3) they impart to the cutting tool or work the motion required for cutting or forming the part; 4) they regulate the cutting speed and the movement between the tool and work.

The most common machine-tools are lathes, which perform cutting operations mostly, milling machines, drilling machines and grinders.

Lathes. In addition to the *engine lathe*, there are quite a number of higher-production lathes, including tracer lathes, Swiss-type automatic screw machines, turret lathes, and single- and multispindle automatic lathes. *Tracer lathes* are similar to the engine lathe, but the tool path may be guided by a template-template type, tracing the operation is automatic, but the operator has to position the tracing-tool unit for each cut and return it to the starting position for the next cut. Swiss-type automatic screw machines are designed to produce small-diameter parts, such as shafts for clocks or watches. The cutting tools are arranged in a radial pattern around the

workpiece. A unique feature is that the stock can be fed longitudinally while it is being cut to generate curved surfaces. Accuracies on small production parts may be held to 0.0005 inch (0.0013 mm).

A *turret lathe* is made with two turrets, one at the tailstock end of the machine and the other mounted on the cross-slide. Each of the tools on either of the *turrets* can be indexed (rotated) and locked into position and then brought up to the stock for the desired cut. On a manual-type turret lathe, the operator does the indexing, but the tools are fed into the workpiece by power.

"*Single-spindle automatics*" are turning machines whose movements are directed by gears and cams. Automatics can be used for bar or individual pieces held in a *chuck*, which are then referred to as "chuckers." These machines are fast but are economical only for large production runs. One person can operate two or more machines of this type simultaneously. *Multispindle automatic lathes* are built somewhat similar to the single-spindle automatics but are equipped with four, six, eight, or more spindles. Either the bar stock or individual pieces may be held in the chucks. After the necessary cuts are made at each station, all the chucks rotate, or index around. This continues until all workpieces have been machined. A newer concept in turning is the numerically controlled lathe with a built-in computer.

Transfer Machines. The highest degree of automation in metalworking production is made possible by the transfer machine. A transfer machine is essentially a combination of individual machine tools arranged in the required sequence, connected by material-handling or transfer devices and integrated by interlocking controls. On these specially built machines, hundreds of operations are performed and inspected automatically. On large parts such as automotive engine blocks, part-turnover and orienting devices often are used between groups of work stations to present new surfaces to the horizontal, vertical, or angular machining units.

Vocabulary

shape	форма
cut	різати
rugged	міцний, жорсткий, шерохуватий
precise	точний
serve a purpose	мати призначення
milling machine	фрезерний верстат
drill	свердлити
grind	шліфувати
hand-fitting	ручна підгонка
turret	головка верстата
longitudinal feeding	повздовжня подача
transverse feeding	поперечна подача
curved	не прямий
tailstock	задня опірня центруюча бабка
lock	стискати
trace	слід
tracing-tool unit	креслячий пристрій
workpiece	заготовка
lathe	токарний верстат
template	матриця
spindle	вал, стрижень, вісь
turn	точити, обточувати
chuck	зажимний патрон, оправка

2. Complete the sentences.

1. Machine tool is ____ .2. It is used ____ 3. Lathes ____ engine
lathe ____ 4. Tracer lathes ____ 5. Swiss-type automatic screw machines
____ 6. A turret lathe ____ 7. Single-spindle automatics ____ 8.
Multispindle automatic lathes ____

3. Translate the questions and answer them.

1. Що являє собою сучасний механічний верстат? 2. Для яких операцій використовується механічний верстат? 3. Як обробляється метал на металорізальному верстаті? 4. Які спеціальні верстати можуть бути у металообробному цеху і які операції вони виконують? 5. Яка найважливіша властивість сучасних механічних верстатів і чому? 6. Яке призначення можуть мати механічні верстати?

4. Fill in the blanks.

arranged, precision, impart, tracer, substituted, template-template, stock, repair, driven, stool, transfer, serve, hold, lathes, perform, milling, cutting.

Machine _____ is any of a wide variety of tools, usually large, rugged, and power _____, for _____, shaping, or forming metal. _____ of operation makes it possible to produce hundreds of identical parts, all so much alike that they may be freely interchanged or _____ in assembly or _____, without hand-fitting. Machine- tools are known to _____ four main purposes: 1) they _____ the work or part to be cut; 2) they hold the cutting tool (or tools); 3) they _____ to the cutting tool or work the motion required for cutting or forming the part; 4) they regulate the cutting speed and the movement between the tool and work. The most common machine-tools are _____, which _____ cutting operations mostly, _____ machines, drilling machines and grinders. Swiss-type automatic _____ lathes are similar to the engine lathe, but the tool path may be guided by a _____ type. The cutting tools are _____ in a radial pattern around the workpiece. The _____ can be fed longitudinally. A _____ machine is essentially a combination of individual machine tools arranged in the required sequence.

5. Group the synonyms and use them in situations.

form, operate, act, alike, finish, shape, work, move, machine, perform, exact, run, cut, lathe, process, position, grind, identical, precise, place, changed, mill, treat, substituted, location, tool, similar, edge, point.

6. Define the words with the same root and use them in situations.

drill – drilling, cut – cutting – cutter, bore – boring, turn – turner – turning, grind – grinder – grinding – ground, mill – miller – milling, drive – driver – driving, assemble – assembled – assembling, move – movable – motion, design – designer – designing.

7. Make up compound words.

machine, cutting, metal, power, hand, multi-, stage, driven, tool, fitting, tape, working, cutter, spindle, stage, processing, shaft, tool, operations, lathe.

8. A. Describe the machine tools using Gerund instead of Participle.

Model. milling machine – machine for milling.

drilling tool, controlling device, the screw-cutting lathe, planing process, reaming operation, tracing action.

B. Describe different tools and metal machining operations. Use the model.

Model. We can see the tools / treating / processing the metal parts.

turn, bore, grind, shear, press process, machine, cut, drill, ream, mill, plane, shape, feed, coin, emboss, forge, extrude, weld, trim (обрізати), solder / braze (паяти), file, broach, hone (обточувати), lap (шліфувати, полірувати).

9. Change the structure of the sentences.

Model. Metal is formed easily . Metal is said to be formed easily.

1. We know that machine-tools serve four main purposes. 2. Pressing is the press-work of metals between press dies. 3. The most common machine-tools are lathes. 4. Forging is localized plastic working of metals. 5. They design Swiss-type automatic screw machines that produce small-diameter parts. 6. Now they make transfer machines that perform and inspect automatically hundreds of operations. 7. Metal is extruded by placing it in a

chamber and forcing it through a die.

10. Translate the following text into English.

Опис верстату, що використовується на виробництві.

Багаторізцевий токарний верстат мод. 1а730

Токарні багаторізцеві верстати призначенні для обробки одночасно усіма різцями, які встановленні у передньому та задньому супортах; використовуються у серійному виробництві. На цих верстатах краще всього обробляти багатоступінчасті вали.

Використовуючи спеціальну копіювальну лінійку, можна обробляти і фасонні поверхні. Найбільший діаметр для верстата мод. 1А730 300 мм, а довжина 500 мм. Верстат має два супорта: на передньому встановлюється одночасно всі різці, які працюють на поздовжніх подачах, а на задньому – різці, які працюють на поперечних подачах. Зміна швидкостей і подач на верстаті здійснюється колесами. Налагодження та наладка здійснюється наладчиком, а робота на верстаті не потребує великої кваліфікації.

Основні частини і елементи різця. Різець (рис. 35.2) складається з робочої частини, або головки 2, і тіла 6, або стрижня, який призначений для закріплення різця в різцетримачі. Головку різця заточують так, щоб утворити на ній такі поверхні: передню 5, якою сходить стружка; задні 1 та 7, обернені до заготовки, що обробляється. Перетин передньої і задніх поверхонь утворює різальні кромки різця. Різальну кромку 4, яка виконує основну роботу різання, називають *головною різальною кромкою*, а

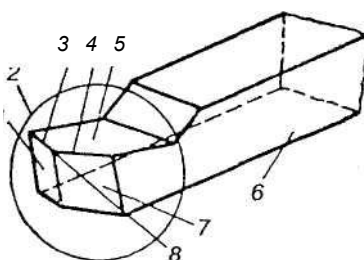


Fig. 35. Основні частини і елементи різця.

різальну кромку 3 — допоміжною. Сполучення головної і допоміжної різальних кромок утворює вершину 8 різця. Задню поверхню 7, що проходить через головну різальну кромку, називають *головною задньою поверхнею*, а поверхню 1, яка проходить через допоміжну різальну кромку — *допоміжною задньою поверхнею*.

11. Discuss the following topics.

1. The kinds and the purpose of the tools. 3. New concept in mechanical tools. 4. Spheres of tools application.

12. Consider the mathematical notion and tell what you know on the topic.

Sequences

Functions whose domain is the set of positive integers play an important part in analysis. Such functions are frequently called sequences. The limitation of the domain may be implicit in the formula which defines the function, as happens with a function such as $(x-1)$; but $f(x) = x^2$ would also be called a sequence if the argument were specifically restricted to positive integral values.

It is customary to use the letter n , rather than x , to represent a general value of the argument of a sequence. The numbers $f(1)$, $f(2)$ etc. are called the terms of the sequence. It is also a common practice to denote the n^{th} term of a sequence by the symbol u_n , rather than $f(n)$, especially in connection with infinite series; this notation will be adopted whenever it is found to be more convenient.

The graph of a sequence is a set of isolated points.

Definition: If, for any number A it is possible to find a number q (depending on A) such that, for all integers $n > q$, $f(n) > A$, then $f(n)$ tends to infinity.

The definition of $f(n) \rightarrow -\infty$ is similar.

Vocabulary

sequence	послідовність, ряд
domain	область

Text 2

9. Read, entitle the text and speak about the developments in tools.

James Watt made significant improvements on the steam engine invented by Thomas Newcomen. This was accomplished by John Wilkinson on a boring machine he built in 1775 — the first machine tool. Machine tools that followed in the 19th century were the screw-cutting lathe, metal planer, and milling machine. Eli Whitney, the American who invented the cotton gin about 1793, was also a pioneer in the use of precision tools to mass-produce interchangeable parts.

The chief innovations are numerical control, or NC (control by means of tape containing numerical information), and computer control. Although the control methods are changing, the basic machine-tool operations remain the same; they include turning, milling, drilling, boring, grinding, planing, shaping, shearing, and pressing. The cutting part of a machine tool is called *the cutting tool*. The actual cutting is done by a sharp point or a sharp edge. A tool with one cutting point is called a single-point tool.

Text 3

1. Read the text and express your attitude to its content.

Metal Processing Operations

Hole Making. The principal methods of making and enlarging holes are drilling, reaming, and boring.

Drilling. The most common drilling machine is the upright sensitive

drill press. The table is adjustable in height and tilt angle, and a powered spindle (holding the drill bit) can be fed down into the workpiece by a hand-operated lever. The manual feed gives the operator a feel for the cutting action of the drill — hence the term "sensitive." Power feeds are added to the larger drill presses.

Gang drills essentially are upright drill presses placed side by side, with a common table. Parts can be easily drilled, reamed, counterbored, and so forth by being transferred from one spindle to the next without lost time for tool changing. When the workpieces become too large to be moved conveniently around on the drill-press table, a *radial drill* is used. The radial drill has a horizontal arm that extends out from the main column. The independently driven drilling head mounted on the arm can be swung in an arc, raised or lowered, or tilted.

When holes are needed in groups, a *multiple-spindle drilling head* is used. In most cases the positions of the drills can be adjusted within the overall cluster arrangement almost at random. A *turret-type drill press* is one of the most effective types for offering a variety of cutting tools. Tool selection, speeds, and feeds can be numerically controlled.

Boring. Boring is the process of enlarging and truing an existing hole. Often, when a hole is drilled, it is not exactly centered on the desired location. For this reason the hole is drilled undersize by $\frac{1}{32}$ to $\frac{1}{16}$ inch (0.08-0.16 cm); the hole can be bored to the desired diameter and centered. Boring often is done on a lathe with the work mounted in a chuck and the boring bar mounted in the tool-post holder on the compound. *Jig boring machines*, which resemble vertical mills, are used for precision hole location and boring.

Reaming. Reamers are used to produce accurate hole size and good finish. Holes are often drilled 0.015 to 0.03 inch (0.038-0.076 cm) undersize to allow for reaming.

Turning. Turning is the process of machining round stock on a lathe. The commonest use of the lathe is for machining workpieces to various diameters. Other operations include drilling, boring, threading, knurling, and tapering.

The lathe's quick-change gear box provides an easy way of changing feeds. Feed is the amount that the tool (mounted on the carriage) advances per revolution of the workpiece. The feed determines the finish obtained.

Other operations of metal treatment are: *grinding, planing and broaching.*

Electron-beam welding is increasingly favored where the cost of the equipment can be justified by the production volume. *Ultrasonic welding and machining* has found wide acceptance in nondestructive testing, welding, and machining.

Vocabulary

hole making	вироблення отворів
boring	буріння
upright	прямий
gang drill	набір свердел
ream	розточувати, розсвердлювати
counterbore	цековати, оброблений отвір
tilt	нахил, кут нахилу
clamp	перехилляти, перевалювати
cluster	набір (різців)
at random	навмання
tool-post holder	різцеутримувач
knurl	насічка
taper	надання форми конусу
size	розмір
adjust	прикріплювати
finish	кінцева обробка

3.Translate the text into English.

Основні методи обробки різанням

Обробка конструкційних матеріалів різальними інструментами (обробка різанням) полягає у відокремленні ними з заготовки шару матеріалу з метою виготовлення деталі потрібної форми, відповідних розмірів і шорсткості поверхонь.

До основних методів обробки різанням належать: точіння, свердління, фрезерування, стругання, протягання, шліфування.

Головним рухом із швидкістю V при *точінні* (рис. 36. 1, а) є обертання виробу 2 навколо своєї осі, а рухом подачі — поступальний рух інструмента 1 відносно виробу та вздовж своєї осі. При свердлінні отворів на верстатах токарної групи головним рухом є обертання заготовки 2, а рух подачі здійснює свердло.

При *фрезеруванні* (рис. 36. 1, в) головним рухом є обертання інструмента 7, а рухом подачі — поступальне переміщення заготовки 2 або фрези. Застосовуючи різноманітні фрези і фрезерні верстати, можна обробляти різні поверхні та їхні комбінації: площини, криві поверхні, уступи, пази тощо.

Головним рухом при *струганні* (рис. 36. 1, г) є зворотно-поступальне переміщення різця 1 в поперечно-стругальних верстатах або заготовки 2 в поздовжньо-стругальних. Рухом подачі є періодичне переміщення заготовки або різця.

Протягання (рис. 36. 1, д) здійснюють за допомогою спеціального різального інструмента-протяжки 1, що має на робочій частині різця зубці, які рівномірно підвищуються вздовж протяжки. Головним рухом є поздовжнє переміщення інструмента 2, а руху подачі немає.

Головним рухом у *шліфуванні* (рис. 36. 1,є) є обертання шліфувального круга *1*. Рух подачі здебільшого комбінований, тобто складається з кількох рухів. Наприклад, при круглому зовнішньому шліфуванні — це обертання заготовки *2*, поздовжнє переміщення заготовки відносно шліфувального круга і періодичне поперечне

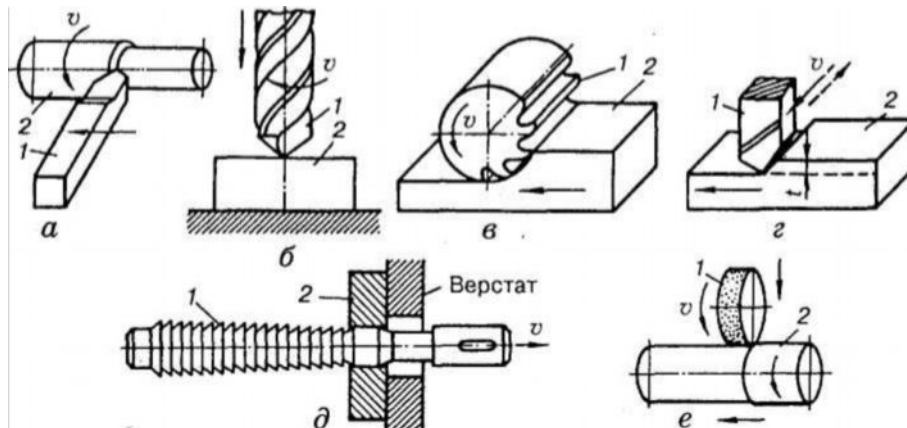


Рис. 36. Схеми основних методів обробки різанням

переміщення шліфувального круга відносно заготовки.

При *свердлінні* отворів на свердлильних верстатах (рис. 36. 1, б) головним рухом є обертання інструмента *1*, а рухом подачі — переміщення інструмента.

4. Discuss the metalworking shop.

1) Equipment, 2) Metal processing operations, 3) Advantages and disadvantages of machine tools.

ELECTRICITY

UNIT 15

1. Learn the notions and their definitions.

Electrical and Electronic Engineering The branch of engineering that deals with the effects and processes resulting from the behavior of tiny particles of matter called electrons.

Electric current a flow of free electrons through a conductor.

Conductance the property of a substance to carry out electricity.

Resistance the property of an electric circuit to convert power from electrical form to heat.

Electromotive force the work per unit charge done by the charges in moving from one point to the other.

Volt a unit of measuring electromotive force and electric potential.

Polarity concept of negative and positive.

Voltage difference between two points.

Transformer the device by which A. C. voltage is changed.

Battery a device by which chemical energy is transformed into electrical energy.

Generator a device by which mechanical energy is transformed into electrical energy.

Force of the electric current the work per unit charge done by the battery.

Text 1

2. Read, translate and retell the text.

Electric Current

Electricity is a flow of an electric current now accepted as a slow drift of so-called "free electrons" through a conductor. When free electrons from one atom displace free electrons in a second atom, which in turn displace free electrons in another atom a continuous motion along a conductor takes place. This electron drift is known as current flow. When an electromotive force or voltage is impressed across a conductor, a field of force inside the conductor is created and electrons flow. This field gives direction to the random

movement of the free electrons and causes their coordinated slow drift from one atom to another.

There are two general methods by which a continuous supply of electrical charge is obtained; one being by means of a battery, and the

other being by means of an electric generator.

The battery is known to be a device by which chemical energy is transformed into electrical energy and the generator as a device by which mechanical energy is transformed into electrical energy.

The electric circuit is a continuous path through which current flows, if an electromotive force (a battery), conductors (wires), and resistances (electric lamps or motors) are combined in a such a way as to have current flow an electric circuit has been made. Thus the circuit is closed. One wire is for the current to flow to the electrical device from the power supply. The other wire is to allow the current to return to the source of energy. Sometimes a circuit is made completely by grounding it. When a circuit is broken so that a current is no longer able to pass, the circuit is said to be an open circuit. Electric devices in the circuit may be connected in series or in parallel.

A difference of potential determines the direction of electron flow. Electrons flow from the point which has an excess of electrons to a point that has a deficiency of electrons: that is electrons flow from negative (-) to positive (+). This concept of negative and positive is called polarity.

Regardless of whether the current is DC, AC or pulsating DC, the direction of electron movement in a conductor is from negative terminal to positive. Within a source of electromotive force such as a battery the electrons move from positive to negative. The device by which A. C. voltage is changed is called a transformer.

Vocabulary

electronic device	електронний прилад
flow, current	струм
conductor	провідник
fields of force	силове поле
random movement	хаотичний рух
drift	плинути
terminal	клемма
voltage	напруга

electromotive force	електрорушійна сила
displace	витіснити, заміщати
excess	надмір, надлишок
deficiency	нестача
source	джерело (струму)
broken circuit	розірване коло
path	шлях
power supply	джерело енергії

Text 2

1. Read, entitle the text and show your attitude to its content.

In 1827 George Simon Ohm discovered that the amount of current which flows in a circuit increases if the potential applied is increased, and decreases if the resistance of the circuit is increased. His findings are known as Ohm's law which states that the current in a circuit is directly proportional to the applied potential and inversely proportional to the resistance. The proportionality constant is the electrical resistance.

$$\text{Resistance} = \frac{\text{potential difference}}{\text{current}}$$

Symbolically, Ohm's law is often written

$$R = \frac{V}{I}, \text{ or } 1 \text{ ohm} = \frac{1 \text{ volt}}{1 \text{ ampere}}.$$

Using Ohm's law is of great importance because of its being generally applied to so many electrical phenomena. One of its simplest applications is using a dry cell directly connected by wires to a small light bulb. The battery maintains a potential difference of 1.5 volts across the lamp. The electron current flowing through the circuit being 0.5 ampere, the resistance of the circuit is

$$R = \frac{1,5 \text{ volts}}{0,5 \text{ amp.}} = 3 \text{ ohms.}$$

Although electromotive force and potential difference are both

measured in volts there is a real distinction between them. Electromotive force is defined as the work per unit charge done by the battery or generator on the charges in moving them around the circuit. Potential difference between two points is defined as the work per unit charge done by the charges in moving from one point to the other.

If any two of the three quantities: resistance, current and potential difference are known for a circuit, the third can always be determined by substituting in Ohm's law. In other words, any one of the three factors may be the unknown, and Ohm's law may be written in any one of three ways:

$$I = \frac{V}{R}, R = \frac{V}{I}, V = IR$$

Resistance is the property of an electric circuit to convert power from electrical form to heat. The resistance of a circuit element, expressed in ohms, can be computed from the following formula, which gives the power P, in watts, converted into heat by a resistance of R ohms, when a current of effective value I amperes flows through the element:

$$P = RI^2, \text{ or } R = P/I^2.$$

This conversion is the basis of all resistance-type electric heating devices, including electric water heaters, electric resistance furnaces or space heaters, electric ranges, and electric hair dryers. A component connected into an electric circuit to provide resistance, with no reactance, is called a resistor.

Notes. D.C. current – direct current постійний струм.

A. C. current – alternative current змінний струм.

P – power of electric current, measured in watts.

R - resistance to electric current, measured in ohms.

Vocabulary

directly	прямо
inversely	обернено

unit	одиниця
charge	заряд
convert	перетворювати
determine	визначати
substitute	замінювати
maintain	підтримувати
resistance	опірність
measure	міра, міряти
heat	тепло, нагрівати
furnace	ливарна піч
electric range	лінія електоропередачі
hair dryer	фен

2. Translate the questions and answer them.

1. Що таке електрика? 2. Як отримують струм електрики? 3. Як створюється електричний ланцюг? 4. Що відображує закон Ома? 5. Де застосовується закон Ома?

3. Find in the text the equivalents of the Ukrainian words and word combinations.

електричний струм, повільний потік через провідник, утворюється силове поле, під нормальним повним навантаженням, постійний шлях, електричний ланцюг, визначати напрямок, надлишок електронів, кількість току збільшується, прикладений потенціал, закон Ома стверджує, прямо пропорційна, звернено пропорційна, відображається в омах, електричні явища, електричний прилад, постачання енергії, джерело енергії, електрична лампочка, перетворювати енергію, нагрівач повітря, називається резистором.

4. Fill in the gaps.

flows, displace, return, supply, created, causes, decreases, current, combined, applied, grounding, determines, conductor, pass, impressed.

Electricity is a flow of an electric ____ now accepted as a slow drift of so-called “free electrons” through a _____. When free electrons from one atom _____ free electrons in a second atom, which in turn displace free electrons in another atom a continuous motion along a conductor takes place. When an electromotive force or voltage is _____ across a conductor, a field of force inside the conductor is _____ and electrons flow. This field gives direction to the random movement of the free electrons and _____ their coordinated slow drift from one atom to another. The electric circuit is a continuous path through which current _____, if an electromotive force (a battery), conductors (wires), and resistances electric lamps of motors) are _____ (in a such a way as to have current flow an electric circuit has been made. One wire is for the current to flow to the electrical device from the power _____. The other wire is to allow the current to _____ to the source of energy. Sometimes a circuit is made completely by _____ it. When a circuit is broken so that a current is no longer able to _____, the circuit is said to be an open circuit. A difference of potential _____ the direction of electron flow. In 1827 George Simon Ohm discovered that the amount of current which flows in a circuit increases if the potential _____ is increased, and _____ if the resistance of the circuit is increased.

5. Use the model to match the notions and their definitions.

Model. electricity is known to be / is defined as / is referred to as / stands for / is called the flow / current of free electrons.

1) electric current, conductance, resistance, electromotive force, volt, potential difference, voltage, transformer.

2) difference between two points defined as the work per unit charge done by the charges in moving from one point to the other; a unit of measuring electromotive force and electric potential; force of the electric current; the property of a substance to carry out electricity; the device by which A. C. voltage is changed; a flow of free electrons through a conductor; the property of an electric circuit to convert power from electrical form to heat; the work per unit charge done by the battery.

6. Match the derivatives and use them in definitions.

1) electric – electrician – electricity – electron, generate – generator – generate, conduct – conductor – conductance – conductivity, resist – resistor – resistance – resistivity – resistant, to measure – measure – measurement – measurable.

2) електрика – електрон – електричний – електрик, напруга, провідник – провідність – проводити, опір – опиратися – опірність – опірний – питомий опір – котушка (елемент опору), вимір – вимірюваний – вимірювати – міра.

7. Group the synonyms and use them in discussion on the topic.

power, details, voltage, alter, elements, measure, continious, carry, job, tention, engagement, force, convert, work, check, transform, essential, occupation, basic, conduct, principal, parts, constant, energy, components, vary, change.

8. Desipher and translate the abbreviations.

D.C., A.C., e.m.f., h.p., lb, s.w., r.p.s., yd, sc., p.s.i.

9. Use the models to transform the sentences into the Subjunctive Mood.

Model 1. The Common Aspect. I suggest, demand, require order, suppose, insist, that we should gather after classes.

Model 2. The Common Aspect. Should you meet him tomorrow, tell him to come.

Model 3. The Perfect Aspect. It is impossible that you should have thought so before we met.

Model 4. The Continious Aspect. He should be speaking tomorrow.

Model 5. The Perfect Continious Aspect. He should have been speaking yesterday.

1. To work with electricity you must take care not to touch a bare wire. 2. It is necessary to measure voltage. 3. They suggest the students to make the electric circuit. 4. We are advised to cut off electricity not to have electric shock. 5. All people are ordered to economize electricity. 6. It is required to pay for electricity in time. 7. They were warned not to touch the cables in order not to be killed. 8. If you happen to repair your electric iron, mind the insulation. 9. When the main source of energy is going to be the sun we will be able to breathe with fresh air. 10. If he, by chance, worked at the power plant, he would know its scheme well.

10. Use the infinitives, participles or gerunds.

All matter is known (consists) of atoms which contain electrons, protons and neutrons. The atoms are tied together, (form) a chemical compound, the number of electrons in the outer shell of the atom of an element (determine) the chemical properties (valence) of the element.

Now we know a current through a conductor (be) actually a movement of electrons, (make) an electric-current flow continuously along a wire.

There are at least four principal methods for (generate) electric currents: chemical reaction, thermal or heat action, light action, magnetic action. (Produce) a current by chemical reaction, an alkali or an acid is made (react) with a metal. The device (use) is called a voltaic or an electric cell, a group of two or more cells (connect) together (form) a battery.

(Produce) current by thermal action is the next method (consider). Heat is certain (produce) current when (apply) to two unlike metals (solder) together in two points. (Fall) on a special kind of cell, a light beam can generate an electric current. The appliance (use) in that phenomenon (produce) electricity is called a photoelectric cell. Photoelectric cells appear (use) in a great number of common devices.

(Generate) a current by magnetic action, a wire is made (pass) through a magnetic field, the latter (be) set up either by a permanent magnet or an electromagnet. The wire (cut) through the magnetic field of an

electromagnet, the apparatus is said, (be) a dynamo electric machine or a dynamo, for short.

11. Translate the following text into English.

Відкриття електрики

Електрика — явище природи, пов'язане з існуванням, рухом і взаємодією *електричних зарядів*. Французькі фізики Ш.-Ф. Дюфе і Б.Франклін встановили існування електричних зарядів двох видів — позитивних і негативних. Було доведено, що між різнойменними зарядами діють сили притягання, а між однойменними — відштовхування. Г. *Кавендіш* і Ш.О. *Кулон* встановили закон взаємодії електричних зарядів. А. *Вольта* створив хімічні джерела електричного струму. В 1802 В. В. *Петров* відкрив електричну дугу і вказав на можливість застосовувати її для плавлення металів та освітлення. *Ерстед*, *Ампер* відкрили закон взаємодії між постійними електр. струмами М. *Фарадей* відкрив закон *електромагнітної індукції*. Загальне правило визначення напрямку індукованих електричних струмів встановив Е. Х. Ленц. Максвелл висунув гіпотезу про єдине *електромагнітне поле*, сформулював рівняння, які є основою електродинаміки. Р. *Герц* експериментально довів існування електромагнітних хвиль. Дослідження Дж.Дж. *Томсона* по визначенню відношення заряду катодних променів до їхньої маси завершилися відкриттям носія елементарного від'ємного заряду — *електрона*. Е. *Резерфорд* запропонував планетарну модель атома. В основу сучасної теорії електромагнітних явищ і будови речовини покладено уявлення про елементарні електричні заряди і взаємодію між ними, а також закони *квантової механіки*. Вчення про електрику має велике практичне значення. Електрична енергія легко трансформується в інші форми (теплову, механічну, хімічну, світлову та ін.), легко передається на

великі віддалі, що сприяє широкому застосуванню її в народному господарстві.

12. Make up dialogues on the following topics.

1. The atomic structure of matter. 2. The phenomenon of electric current. 3. The laws of electricity.

13. Match the words.

1) sets, variety, mapping, bound, limit, real numbers, probability, integration, sequence, function, continuity, equation, differential, maxima and minima, fraction.

2) множинність, послідовність чисел, неперервність, функція, вірогідність, границя (2), диференціал, дійсні числа, інтегрування, рівняння, максимум та мінімум, відображення, дріб, різноманіття.

14. Consider, comment on and exemplify the notion.

Ordinary Differential Equations

1. An ordinary differential equation is an equation involving one or more derivatives of the dependent variable y with respect to a single independent variable x .

The order of the equation is that of the highest derivative contained in it, so that the general differential equation of order n can be written in the form

$$F \{y^{(n)}, y^{(n-1)} \dots y^{(1)}, y, x\} = 0$$

the symbols $y^{(r)}$ denoting $d^r y / dx^r$. The degree of the equation is defined mathematically to be that of its highest order derivative, when the equation has been made rational as far as the derivatives are concerned. The equation

$$y'' = (xy^{5/2} + y')^{\frac{1}{2}},$$

for example, is of order 2 and degree 2, since the equation must be

squared to rationalize the contributions from the derivatives.

Text 3

1. Find in the text the descriptions of motors. Translate the text.

Electric Motors

Electric motor is a machine that converts electrical energy to mechanical energy. When a motor is connected to a source of electrical energy it develops a twisting effort called torque which tends to rotate the shaft of the motor. When the motor shaft is directly connected or geared, belted to a machine, that machine is driven by the motor to produce useful work.

Motors are used to drive the domestic electric appliances, in the modern industry for driving lathed milling machines, printing presses, conveyors, and grinders. Also rail and vehicular transportation systems, water-supply systems, and pump plants are dependent on electric motors.

Direct-current motors still play a significant role. They are used in many applications where a wide range of motor speeds is required — for instance, to drive elevators, machine tools, cranes, and conveyors. A direct-current motor consists of the same essential parts as a direct-current generator, namely, field magnet, armature with its commutator, and brush gear. The armature and commutator are constructed on exactly the same principles as the armature and commutator of a dynamo, and any difference in external appearances of dynamos and motors is due to a modification in the arrangement of the field magnets and frame, designed to give the motor the maximum amount of protection.

Alternating-Current Motors are much more commonly used than dc motors because practically all electric supply systems now in use are ac systems. There are three general classes of alternating-current motors — polyphase induction, polyphase synchronous, and single-phase motors.

Three-phase motors are by far the most common kind of polyphase motors simply because 3-phase power systems are much more common than other polyphase systems. Three-phase motors are widely used for industrial service because 3-phase power can be generated and distributed more economically in large quantities than single-phase power. Also, a 3-phase power supply provides the simplest means for producing a rotating magnetic field which is needed in an induction or a synchronous motor for starting or running.

Because most homes and rural areas are provided only with single-phase power, such equipment as household appliances necessarily is driven by single-phase motor. Various designs are used. Other kinds of polyphase motors, such as 2-phase motors, are not considered here.

Three-Phase Motor Principles—Rotating Magnetic Field. The operation of 3-phase induction motors depends on a rotating magnetic field in the air gap between the stator (stationary part) and the rotor. The commutator of the 3-phase motor has three individual and identical windings arranged symmetrically around its periphery.

3. Match the words and expressions, use them to retell the text.

1) singlephase, polyphase, core, household appliances, convert, coil, torque, brush gear, metre, twisting effort, winding, connect in parallel, in sequence, terminal, field magnet, source, commutator, arrange, reverse.

2) перетворювати, приєднувати, клемма, джерело, крутне зусилля, обертальний момент, зворотній, обмотка, магніт збудження, щітка, котушка, колектор, сердечник, якор, клемма, з'єднувати послідовно, з'єднувати паралельно, ярмо.

4. Fill in the blanks.

brush gear, force, field magnet, converts, source, dependent, connected, driven, develops, current, rotate.

The electric _____ generated by electro-motive _____ is produced in

the conductors. A direct-current motor consists of the same essential parts as a direct-current generator, namely, ____, armature with its commutator, and _____. Electric motor is a machine that _____ electrical energy to mechanical energy. When a motor is connected to a _____ of electrical energy it _____ a twisting effort called torque which tends to _____ the shaft of the motor. When the motor shaft is directly _____ or geared, belted to a machine, that machine is _____ by the motor to produce useful work. The core is made of iron with high ohme _____. All modern machines are _____ on electric motors.

5. Translate the following text into English.

Електродвигун – електрична машина, що перетворює електричну енергію на механічну. Складається в основному з обертової частини (*ротора*) й нерухомої частини (*статора*). Розрізняють *електродвигуни постійного струму, змінного струму електродвигуни* й електродвигуни універсальні. Універсальними називаються колекторні електродвигуни з послідовним збудженням, що діють при живленні постійним або змінним струмом промислової частоти. В таких електродвигунах можна регулювати частоту обертання ротора. Потужність електродвигуна — від частин вата (мікроелектродвигуни) до десятків мегават. Електродвигун — складова частина *електропривода* деяких засобів рейкового (наприклад, *електровоза*) і безрейкового (*електрокара, електромобіля*) транспорту, підйомно-транспортних машин, механізмів на судах, літаках тощо.

6. Make up dialogues on the following topics using the introductory and connective words.

1. Application of electricity at home and in production. 3. Electric machines. 3. Modern electric motors.

TECHNICAL DOCUMENTS. PATENT

UNIT 16

Text 1

1. Read and translate the text, paying attention to the specific patent expressions. Describe the drawings.

Patent Specification

Improvements in or Relating to Pipe Joints or Pipe Couplings

The pipe joint or coupling forming the subject of the present invention, although applicable for use with pipes of any material, is particularly concerned with pipes or tubes of semi-flexible character and composed of comparatively hard thermoplastic synthetic resin composition, natural or synthetic rubber or similar material. The pipe joint or coupling is also suitable for use with metal pipes.

A pipe joint or coupling in accordance with the invention comprises a body bored to receive the extremity of the pipe and to form an internal shoulder or sitting against which the pipe can abut, a sleeve nut surrounding the pipe and in threaded engagement with the body, a longitudinally split pressure ring having an externally arranged tapered extremity for engagement by a correspondingly tapered surface on the interior of the nut so as to contract the pressure ring into gripping engagement with the pipe and an annular sealing ring in abutting engagement with the pressure ring and formed with a fine taper for engagement with a tapered surface in the interior of the body for the purpose of maintaining a good seal consequent upon tightening of the nut on the threaded part of the body. If composed of suitable material the sealing ring will be contracted into good sealing engagement with the pipe.

Referring to the drawings:

Figure 1 is a side elevation of a pipe joint or coupling in accordance with the present invention; and

Figure 2 is a longitudinal section of the same drawn to an enlarged scale.

The pipe joint or coupling illustrated includes a body 1 which may be externally screw threaded as at 2 for attachment to a container or the like, the body being formed with a cylindrical boring 3 and with a boring extension involving a tapering surface 4 and a shoulder 5. The pipe 6 enters boring 3 and seats on the part 5, the latter forming a square shoulder against which the peripheral edge of the pipe abuts.

The body is externally screw threaded at 7 to engage internal screw threads on a sleeve nut 8 having an inner tapering surface 9.

The tapered boring 4 receives an externally tapered sealing ring 10, the latter having a slightly finer taper than the boring, the ring fitting closely around the pipe. The opposite end of the sealing ring has a square face of a pressure ring 12, the latter being split longitudinally at one or more points 13 around the periphery whereby it will be contractable with a minimum of effort into good sealing engagement with the pipe.

The pressure ring is formed with a tapered surface 14 corresponding with the tapering surface 9 on the interior of the sleeve nut, whereby the pressure ring will be contracted radially into good sealing engagement with the pipe when the sleeve nut is tightened.

The pressure ring is preferably formed with two or more cylindrical faces 15 which make surface engagement with the pipe over a small surface area, whereby the pressure at the places of contact will be substantially increased.

It will be appreciated that by tightening the sleeve nut 8 pressure ring 12 will not only be contracted radially into good sealing engagement with the pipe but will also bear hard on the sealing ring 10, thus forcing it down the tapered boring into good sealing engagement with the tapered face 4,

the sealing ring at the same time being compressed radially into intimate engagement with the walls of the pipe.

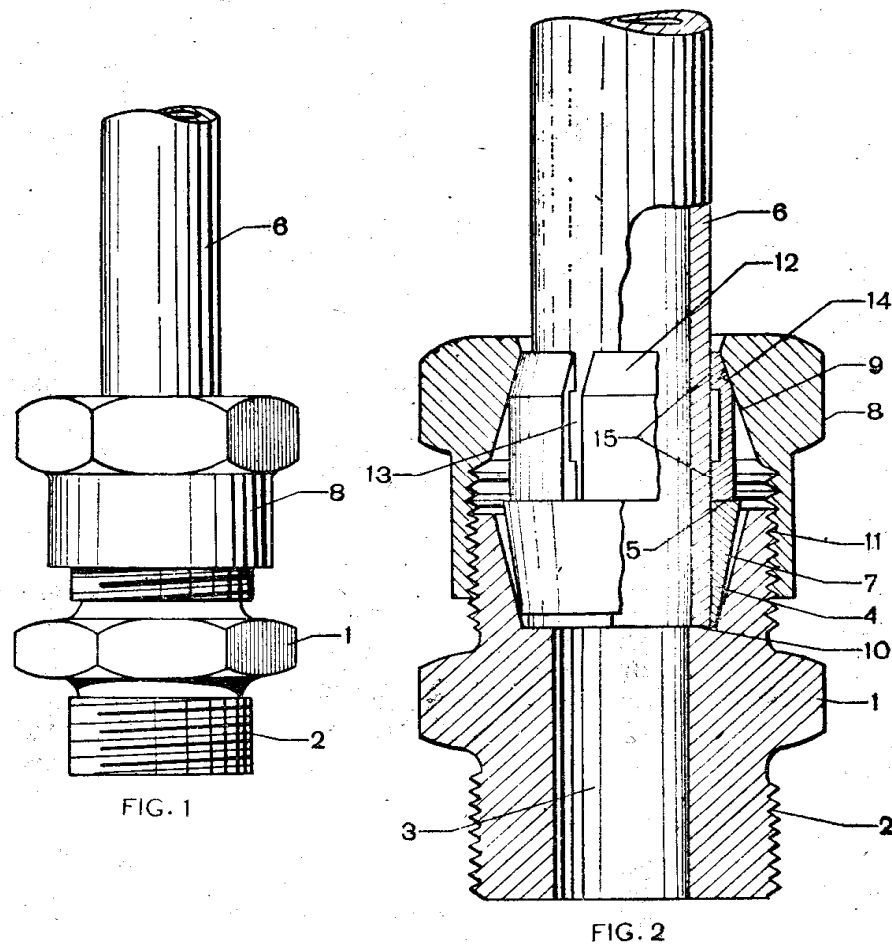


Fig.37.

The rings 10 and 12 are composed of suitable metals to suit the material of which the pipe is composed, and it is within the scope of the invention to employ other materials.

The taper of the sealing ring 10 is preferably in the region of 10° , it being preferred that there shall be a difference of approximately $2\frac{1}{2}^{\circ}$ between the tapers of the two tapering surfaces.

Vocabulary

tapering	конусоподібний
rubber	гума
extremety	край, кінець

abut	упиратися
sleeve nut	муфта, втулка, гільза
contract	скорочувати, стискати
taper ring	запорне кільце
tape	стрічка
extend	поширюватись
median line	серединна лінія
rear corner	задній (тільний) кут
film	плівка
lid	кришка
branch pipe	патрубок
bud	підвіз
pipe-bend, elbow	відвід
irrigating	зрошувальний
step	крок
favour	сприяти
nozzle	насадка
twisted	закручений
butterfly valve	дросельний клапан
throttling	дроселювання
actuator	привод
furnish	забезпечувати

3. Say whether it is true or false and give your grounds.

1. The pipe joint or coupling is applicable for use only with pipes composed of comparatively hard thermoplastic synthetic resin composition.

2. The pipe joint or coupling is also suitable for use with metal pipes.

3. If composed of any material the sealing ring will be contracted into good sealing engagement with the pipe.

4. The rings are composed of suitable metals to suit the material of which the pipe is composed.

5. There shall be a difference of approximately $2\frac{1}{2}^{\circ}$ between the tapes of the two tapering

surfaces. 6. A pipe joint doesn't comprise a sleeve nut. 7. The pressure ring is formed with a tapered surface corresponding with the tapering surface on the interior of the sleeve nut. 8. The pressure ring is preferably formed with one cylindrical face.

4. Answer the following questions.

1. Is the pipe joint or coupling applicable for use with pipes of any material? 2. What is suitable for use with metal pipes? 3. What does a pipe joint or coupling comprise? 4. Under what conditions will the sealing ring be contracted into good sealing engagement with the pipe? 5. What is the pressure ring preferably formed with? 6. What metals are the rings composed of? 7. What is the difference between the tapes of the two tapering surfaces?

5. Find the word combinations in the text and use them in retelling the text.

трубне з'єднання, даний винахід, застосовується з (2), придатне для, запорне кільце (2), в зачепленні з, зубчасте зачеплення, конусоодібна поверхня, конусоподібний отвір, нарізна поверхня, утворювати внутрішній пояс (фланець), тісно підігнане до, повздовжньо розрізане, пресове кільце, у внутрішньому зачепленні з.

6. Fill in the blanks.

suitable, abut, longitudinally, forming, engagement, contract, concerned, annular, seal, applicable, tapered, bored, accordance.

The pipe joint or coupling _____ the subject of the present invention, although _____ for use with pipes of any material, is particularly _____ with pipes or tubes of semi-flexible character. The pipe joint or coupling is _____ for use with metal pipes. A pipe joint or coupling in _____ with the invention comprises a body _____ to receive the extremity of the pipe and to form an internal shoulder or sitting against which the pipe can _____, a sleeve nut

surrounding the pipe and in threaded ____ with the body, a ____ split pressure ring having an externally arranged tapered extremity for engagement, so as to ____ the pressure ring into gripping engagement with the pipe and an ____ sealing ring in abutting engagement with the pressure ring and formed with a fine taper for engagement with a ____ surface in the interior of the body for the purpose of maintaining a good ____ consequent upon tightening of the nut on the threaded part of the body.

7. Write down brief information from the patent according to its principal parts and translate it in writing:

The title.

The head (registration data).

The preliminary description (usually the first paragraph).

The complete description.

The formula.

8. Explain in English the difference between these notions.

1. sealing / gripping / abutting engagement, 2. sealing / pressure ring, 3. tapering surface / boring extension, 4. externally screw threaded / engaged.

9. Fill in the Participle I or Gerund.

1. The pipe joint (be) the subject of the present invention is particularly concerned with pipes or tubes of semi-flexible character. 2. The body is externally screw (thread) at 7 to engage internal screw threads on a sleeve nut (have) an inner (taper) surface. 3. The pressure ring is formed with a (taper) surface on the interior of the sleeve nut. 4. The problems (discuss) are connected with the improvements in or (relate) to pipe joints or pipe couplings. 5. (Illustrate) properly, the information was presented in a very clear form. 6. (Test) this invention showed good results. 7. (Make) of aluminium the parts of the mechanism were very light.

10. A. Transform gerunds, participles and subordinate clauses into infinitives.

1. Some students love translating texts. 2. Creating new things is a fascinating occupation. 3. For inventing machines one should know mechanics. 4. The job that we should do is connected with our speciality. 5. Here is the drawing illustrating the design.

B. Compress the subordinate clauses by infinitival and participial complexes.

1. They test the tubes that must be employed In this device 2. We consider that all the bodies consist of atoms. 3. The current which passes the electrons move in the wire. 4. We know that ohm is the unit of resistance. 5 After the atom has lost some of its electrons, it has a positive charge. 6. We know that ohm is the unit of resistance. 7. Electronic devices, as we know, control the system of electrons. 8. The engineer wants that new devices could be tested in the laboratory. 9. It is said that plastics technology marks a new era of molecular engineering. 10. It appears that robots are already used at home. 11. The machine is improved so that it could pass testing.

11. Use the Conditional Mood to express regret and opinion about the unfulfilled (unreal) action in the past.

Model 1. If only he / could / might illustrate the design!

Model 2. I would / could / might have given you a piece of advice.

12. Use the English patent stamps in a virtual brief patent specification of a known machine or a machine part.

relates to / in connection with	пов'язаний з, відноситься до
in accordance with the invention	у зв'язку з винаходом
the subject of the present invention	об'єкт поданого винаходу
is particularly concerned with	зокрема пов'язаний з
not exclusively	не виключно
in such purposes	для такого застосування

we claim	ми заявляємо
the said, referred to	вищезгаданий
comprises	включає
more particularly	більш конкретно
suppose	уявляти
the former	попередній
the latter	останній

13. Translate the sentences into English:

1. Згідно з цим винаходом, механізм двошвидкісного механічного приводу включає вал з різьбленням та черв'як (шнек), монтований на названому валу. 2. Згідно з кресленнями, електричний мотор необхідний для керування кінцевим валом приводу. 3. Контролюючий засіб може примушувати мотор змінити напрямок руху. 4. Взаємодія гвинта та гайки спричиняє поздовжній рух черв'яка від зупинки. 5. Як заявлено, цей винахід пов'язаний з механізмом настройки радіоприймача.

14. Make up dialogues on the following topics using the Conditional Mood, the verbals, the Passive voice as well as the introductory and connecting words.

1. Kinds of technical documents and the difference between them.
2. The purpose of the patent. 3. The form of the patent. 4. Patent terminology.

15. Consider, comment on and exemplify the notions.

Analytical and Numerical Solutions

With analytical methods we try to obtain a solution in explicit form $y = f_1(x)$, (1), or implicit form $f_2(x, y) = 0$ (2), containing the required number of arbitrary, constants. The functions f_1 and f_2 may include only the elementary functions $\sin x$, e^x , etc., or involve higher mathematical

functions such as those of Airy and Bessel. In practical work; however, the most important usual requirement is that y should be expressible quantitatively in terms of x , by means of a graph if no great precision is needed, or otherwise by a table of values of y calculated at various points in the range of x . In a useful analytical solution, therefore, the functions obtained in it must be well-known and adequately tabulated.

Even in this case, however, much computation may be needed to produce numerical results from an analytical solution. For example, the simple differential equation

$$y' - \frac{2y}{1-x^4} = 0$$

has the solution

$$y = A \left(\frac{1+x}{1-x} \right)^{\frac{1}{2}} e^{\tan^{-1}x}.$$

Text 2

1. Read and translate the patent claim below. Imagine its drawing.

Culinary Knife

3,192,623

Int. Cl. B26b U. S. Cl. 30—24

1 Claims

In a knife, a handle, an angular, outwardly reduced blade comprising two triangular blade segments rectangularly disposed to each other on a common median line longitudinally affixed to one extremity of said handle and extending outwardly therefrom on the axis thereof, a pair of short parallel guide prongs disposed at one side of said blade in a vertical plane parallel to the vertical plane through the median line of said blade and intersecting one rear corner of said blade, a pair of elongated parallel prongs disposed at the opposite side of said blade in a vertical plane parallel to the

vertical plane of said short prongs intersecting the opposite, rear corner of said blade and lying in the same horizontal planes, respectively, as said guide prongs whereby when said blade is fully seated in an article to be cut said guide prongs will penetrate the article in the same relative position as said elongated prongs, and will serve as a guide thereof on the next cut.

Vocabulary

knife	кухонний ніж
angular blade	кутове лезо
dispose	розмістити
affix	прикріпити,
prong	зуб, загострений інструмент
penetrate	проходити через, пронизувати

2. Translate the following text into English using the dictionary.

**Прилад для закривання та герметизації кришки кухонної
каструлі при варці під тиском**

Експрес-інформація

Прилад складається з регульованої по довжині металевої стрічки, яка оперізує каструлю; нажимного ковпака, який покриває центральну частину кришки з ручкою; горизонтального важеля з рукояткою, укріпленого в середині вертикальної дужки, передбаченої на верхній стінці ковпака; регульованої по довжині тяги, що відходить униз від переднього кінця важеля біля рукоятки, яка кріпиться нижнім кінцем до одного з двох гачків, розташованих на діаметрально протилежних ділянках стрічки; та пружини, яка з'єднує задній кінець важеля із другим гачком.

Для герметизації та закривання кришки між нею та каструлею з надягнутою стрічкою розміщують кільцеву уплотнюючу прокладку.

Ковпак с важелем встановлюють на кришку і кільце, яке міститься на нижньому кінці пружини, надягають на один из гачків, після чого нажимають на рукоятку и зчеплюють загнутим гачком нижній кінець тяги із другим гачком.

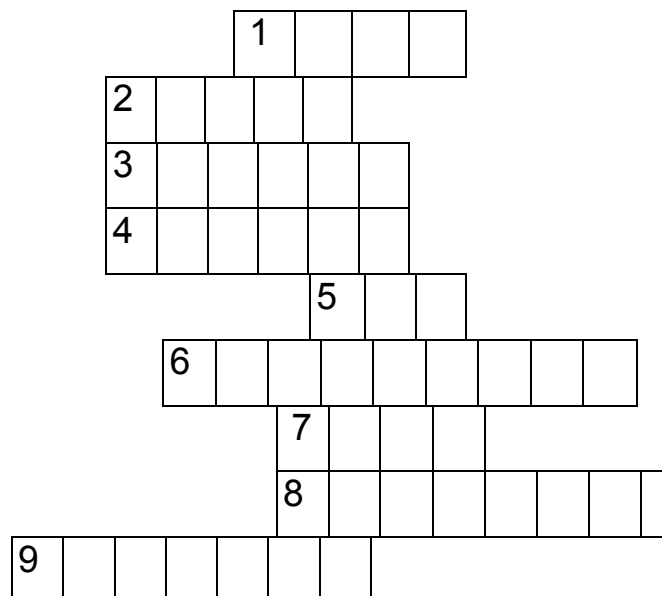
3. Read and translate the technical characteristics of a compressor part. Discuss the use of valves.

Air-Operated Butterfly Valves

Butterfly valves are used for either throttling or two position flow control of air, gas, liquids, steam and fluids with suspended solids.

As for butterfly valve actuators, either spring or springless type G-O-Motors (pneumatic actuator cylinder type) are furnished, depending upon pressure differentials. Allowable pressure differentials both at the closed (0°) and 60° open (maximum opening) positions are therefore an important factor when making selections of butterfly valves.

4. Guess the key word.



1. Something round with a hole in the middle. 2. A kind of material of which pipes or tubes can be composed. 3. Something that can be not only a part of clothes (coat, shirt) but also is used in mechanics. 4. A kind of a material. 5. Something that is screwed on the bolt. 6. Not natural.

7. Something cylindrical with a hole inside. 8. Another word for joint.
8. Another word for joint. 9. This word is an antonym to the verb “to loosen”.

5. Translate the piece of the patent specification from Ukrainian into English.

Опис до патенту на винахід.

Плівковий випарний апарат

Плівковий випарний апарат, який містить парову камеру, нижню ємність, накопичувач, верхню кришку, патрубки підводу та відводу рідини, що випаровується, пару конденсату та неконденсуючихся газів, нагрівальні та зрошувальні труби, та відрізняється тим, що до зрошувальних труб із кроком, який сприяє діаметру нагрівальних труб, геометрично прикріплені криволінійні насадки, розташовані таким чином, що осі їх вихідних каналів спрямовані тангенційно по відношенню до внутрішньої поверхні нагрівальних труб, по яких рідина, яка виходить з насадки, стікає у вигляді закрученої плівки.

6. Fill in the Blank Sample Specification.

Blank Sample Specification

I, (Name) _____ have invented a new design

for a (Title) _____

as set forth in the following specification:

FIG. 1 is a _____ view of a _____ showing my new design;

FIG. 2 is a _____ view thereof;

FIG. 3 is a _____ view thereof;

FIG. 4 is a _____ view thereof;

FIG. 5 is a _____ view thereof; and

FIG. 6 is a _____ view thereof.

I claim: The ornamental design for a

_____ as shown.

Tables of the English Prefixes and Suffixes

Prefixes			
attach	приєднувати	develop	розробляти
believe	вважати, вірити	overwind	перекрутити
engage	зв'язувати	prepare	підготувати
demagnetize	розмагнічувати	restore	відновлювати
determine	вирішувати	interlock	блокувати
include	включати	nonmetallic	не металевий
output	вихід	multicutter	багаторізцевий
impeller	робоче колесо	polifunctional	багатофункційний
disengage	роз'єднувати	propel	рухати
anticorrosion	протикорозійний	subdivision	підрозділ
component	деталь	prewar	довоєний
connect	містити	misalignment	розцентровка
external	зовнішній	transmit	передавати
toward	в напрямку	underlie	підлягати
postwar	післявоєнний	surface	поверхня
semipermanent	напівпостійний	obtain	отримувати

Suffixes			
Nouns		Adjectives	
engineer	інженер	useless	не корисний
linkage	зв'язок	different	різний
treatment	обробка	easy	легкий
measure	міра	important	важливий
production	виробництво	positive	позитивний
resistance	речовина	capable	здатний
precision	дифузія	soluble	розчинний
specialist	спеціаліст	mechanical	механічний
softness	м'якість	liquid	рідкий
mechanism	механізм	dangerous	небезпечний
property	властивість	metallic	металічний
partnership	партнерство	circular	круговий
Verbs			
strengthen	підсилювати	calculate	рахувати
differ	відрізнятися	supply	постачати

establish	встановлювати	mechanize	механізувати
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Додаток 2

**Verbs of motion and doing
Tense Forms. Active Voice**

		Affirmative Sentence (Statement)	Question	Negative Sentence
Simple Tenses	Present	I, we, you, they + V ₁ He, she, it + V ₁ + (e) s	do + S + V ₁ does + S + V ₁	S + do, does = not + V ₁
	Past	S + V ₂	did + S + V ₁	S + did not + V ₁
	Future	I, we shall he, she, it, you, they = will + V ₁	will + S + V ₁	S + shall, will = not V ₁
Continuous Tenses	Present	I am he, she, it, is, you, we, they are = will + V _{ing}	be ₁ + S + V _{ing}	S + be ₁ not + V _{ing}
	Past	S + was (однина), were (множина) + V _{ing}	be ₂ + S + V _{ing}	S + be ₂ not + V _{ing}
	Future	S + will be + V _{ing}	will + S + be + V _{ing}	S + will + be not + V _{ing}
Perfect Tenses	Present	I, you, we, they, have, he, she, it, has + V ₃	have, has + S + V ₃	S + have, has not + V ₃
	Past	S + had + V ₃	had + S + V ₃	S + had not + V ₃
	Future	S + will have + V ₃	will + S + have + V ₃	S + will + have not + V ₃
Perfect Continuous Tenses	Present	S + have, has been + V _{ing}	have, has + S + been + V _{ing}	S + have, has not been + V _{ing}
	Past	S + had been + V _{ing}	had + S been + V _{ing}	S + had not been + V _{ing}
	Future	S + will have been + V _{ing}	will + S + have been + V _{ing}	S + will not have been + V _{ing}

продовження

Passive Voice

Aspect	Tense	Affirmative Sentence (Statement)	Questions	Negative Sentence
Simple Tenses	Present	S + be ₁ + V ₃	be ₁ + S + V ₃	S + be ₁ not + V ₃
	Past	S + be ₂ + V ₃	be ₂ + S + V ₃	S + be ₂ not + V ₃
	Future	S + will be + V ₃	will + S + be + V ₃	S + will not be + V ₃
Continuous Tenses	Present	S + be ₁ + being + V ₃	be ₁ + S + being + V ₃	S + be ₁ not + being + V ₃
	Past	S + be ₂ + being + V ₃	be ₂ + S + being + V ₃	S + be ₂ + not + being + V ₃
Perfect Tenses	Present	S + have, has + been + V ₃	have, has + S + been + V ₃	S + have, has + not + been + V ₃
	Past	S + had + been + V ₃	had + S + been + V ₃	S + had + not + been + V ₃
	Future	S + will have been + V ₃	will + S + have been + V ₃	S + will not have been + V ₃

S – subject – підмет;
 V_{1,2,3} - дієслово у 1-й, 2-й, 3-й формі;
 be₁, – am, is, are;
 be₂ – was, were

Infinitive Forms

Tense	Voice	
	Active	Passive
Indefinite	to ask	to be made
Continuous	to be making	-----
Perfect	to have made	to have been made
Perfect Continuous	to have been making	-----

продовження

Infinitive Functions

Function	Example
Subject	To learn is necessary.
Object	They try to design something unusual.
Attribute	The mechanism to adjust was a shaft.
Adverbial Modifier	He shut off the engine to cool.
Compound Nominal Predicate	Our intention was to help you.

Complex Subject with the Infinitive

The components are said to arrive on Monday.
--

Complex Object with the Infinitive

We know him to be a good student.

Participle Forms

Tense	Voice	
	Active	Passive
Present	making	being made
Perfect	having made	having been made
Past	-----	made

Participle Functions

Function	Example
Attribute	One can economize on tools serving longer.
Adverbial Modifier	Engaging the gears transfer motion.
Part of a compound nominal predicate	The student is solving a problem.

Absolute Nominal Participle Construction

- | |
|--|
| 1. Assembling finished, the conveyer was put into operation. |
| 2. We discussed our problems, the computer working. |

продовження

Gerund Forms

Tense	Voice	
	Active	Passive
Indefinite	using	being used
Perfect	having used	having been used

Gerund Functions

Function	Example
Subject	Working without safety measures is risky.
Object	The device needs repairing.
Attribute	He takes pleasure in assembling cars.
Adverbial Modifier	Use the device after reading instruction.
Part of a Compound Nominal Predicate	Our dream is becoming good specialists.

Infinitive	Past Indefinite	Past Participle (Participle II)	Переклад
arise [a'raiz] awake [a'weik]	arose [a 'rouz] awoke [a'wouk]	arisen [a 'rizn] awaken[a'weikn]	виникати прокидатися, будити бути
be [bi:]	was [wɒz], were [wə:]	been [bi:n]	бити ставати
beat [bi:t] become [bik' ^ m]	beat [bit] became [bi'keim]	beaten ['bi:tn] become [bi'k ^ m]	починатися дути ламати приносити будувати пекти купляти могти хапати обирати різати копати
begin [bi'gin] blow [blou] break [breik] bring [brɪŋ] build [bild] burn [bə:n] buy [bai]	began [bi'gæŋ] blew [blu:] broke [brɒk] brought [brɔ:t] built [bilt] burnt [b ə:nt] bought [bɔ:t]	begun [bi'g ^ n] blown [bloun] broken ['brɒkn] brought [brɔ:t] built [bilt] burnt [b ə:nt] bought [bɔ:t] —	робити малювати мріяти пити вести їсти падати годувати відчувати битися знаходити літати забувати
can [kæn] catch [kaet] choose [tʃu:z]	could [kud] caught [kɔ:t] chose [tʃouz]	caught [k ɔ:t] chosen ['tʃouzn]	отримувати
cut [k ^ t] dig [dig] do [du:] draw [drɔ:] dream [dri:m] drink [drɪŋk] drive [draɪv] eat [i:t] fall [fɔl] feed [fi:d] feel [fi:l] fight [fait] find [faɪnd] fly [flai] forget [fə'get]	cut [k ^ t] dug [d ^ g] did [did] drew [dru:] dreamt [dremt] drank [dræŋk] drove [drouv] ate [et] fell [fel] fed [fed] felt [felt] fought [fɔ:t] found [faund] flew [flu:] forgot [fə 'got]	cut [k ^ t] dug [d ^ g] done [d ^ n] drawn [drɔ:n] dreamt [dremt] drunk [dr ^ ŋk] driven ['drɪvn] eaten [i:tn] fallen ['fɔln] fed [fed] felt [felt] fought [fɔ:t] found [faund] flown [floun] forgotten [fə ' gotn] got [gɒt]	
get [get]	got [gɒt]	got [gɒt]	

продовження

Infinitive	Past Indefinite	Past Participle (Participle II)	Переклад
give [giv] go [gou] grow [grou] hang [h^ŋ] have [hæv] hear [hiə] hide [haɪd] hold [hould] keep [ki:p] know [nou] learn [lə:n] leave [li:v] let [let] lie [lai] light [fait] lose [lu:z] make [meik] may [mei] mean [mi:n] meet [mi:t] pay [pei] put [put] read [rid] ring [rɪŋ] run [r^ŋ] say [sei] see [si:] sell [sel] send [send] set [set] shine [ʃain] show [ʃou] shut [ʃ^t]	gave [geiv] went [went] grew [gru:] hung [h^ŋ] had [hæd] heard [hə :d] hid [hid] held [held] kept [kept] knew [nju:] learnt [lə:nt] left [left] [let] laid [leid] lit [lit] lost [lɒst] made [meid] might [mait] meant [ment] met [met] paid [peɪd] put [put] read [red] rang [ræŋ] ran [ræn] said [sed] saw [sɔ:] sold [sould] sent [sent] set [set] shone [ʃoun] showed [ʃoud] shut [ʃ^t]	given ['givn] gone [gɒn] grown [groun] hung [h^ŋ] had [hæd] heard [h ə :d] hidden ['hɪdn] held [held] kept [kept] known [noun] learnt [lə:nt] left [left] let [let] lain [lein] lighted ['laitɪd] lost [lɒst] made [meid] — meant [ment] met [met] paid [peɪd] put [put] read [red] rung [r^ŋ] run [r^ŋ] said [sed] seen [si:n] sold [sould] sent [sent] set [set] shone [ʃoun] shown [ʃoun] shut [ʃ^t]	давати йти рости висіти мати чути ховати(ся) утримувати тримати знати вчити кидати дозволяти лежати світити втрачати робити могти означати зустрічати платити класти читати дзвонити біти казати бачити продавати посилати ставити сяяти показувати зачиняти

Infinitive	Past Indefinite	Past Participle (Participle II)	Переклад
sing [siŋ] sink [siŋk] sit [sit] sleep [sli:p] smell [smel] speak [spi:k] spend [spend] stand [stænd] strike [straik] swim [swim] take [teik] teach [ti:tʃ] tell [tel] think [θiŋk] understand [,ʌndə'stænd] wake [weik] wear [wɛə] weep [wi:p] win [win] write [rait]	sang [sæŋ] sank [sæŋk] sat [sæt] slept [slept] smelt [smelt] spoke [spouk] spent [spent] stood [stud] struck [strʌk] swam [swæm] took [tuk] taught [tɔ:t] told [tould] thought [θɔ:t] understood [,ʌndə'stud] woke [wouk] wore [wɔ:] wept [wept] won [wʌn] wrote [rout]	sung [sʌŋ] sunk [sʌŋk] sat [sæt] slept [slept] smelt [smelt] spoken [spoukn] spent [spent] stood [stud] struck [strʌk] swum [swʌm] taken ['teikn] taught [tɔ:t] told [tould] thought [θɔ:t] understood [,ʌndə'stud] woken ['woukn] worn [wɔ:n] wept [wept] won [wʌn] written ['ritn]	співати тонути сидіти спати нюхати розмовляти проводити стояти вдарити плавати брати навчати розповідати думати, розуміти прокидатися носити плакати вигравати писати

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